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Supporting Transgender and Gender-Nonconforming Youth Through Teaching Mathematics for Social Justice

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Supporting transgender and gender-nonconforming youth in schools involves changes at all levels of education. Gender-complex education, or education that takes into consideration the existence and experiences of transgender and gender-nonconforming people, should be a basic and pervasive part of curricula and should be seen as critical for students of all gender identities and presentations; it must be infused within every content area, including mathematics. This article synthesizes perspectives on gender-complex education, teaching mathematics for social justice, and research on students' development of proportional reasoning and statistical concepts, and then proposes a mathematics project for middle schoolers to facilitate their agency in challenging transphobia and gender oppression in their schools.

KEYWORDS Gender-complex education, gender nonconforming, mathematics education, middle grades, teaching mathematics for social justice, transgender

Supporting transgender and gender-nonconforming youth in schools involves structural, policy, and curricular changes at all levels of education. Lydia Sausa (2005) found in a study with 24 trans youth that "in most cases, trans youth were unable to access an education because of the constant acts of violence against them based on their gender identity and expression" (p. 19). Moreover, school faculty and staff rarely intervene and sometimes participate in cases of harassment related to gender identity and gender expression (Kosciw & Cullen, 2001; O'Shaughnessy, Russel, Heck, Calhoun,

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& Laub, 2004; Sausa, 2005). Establishing policies that prohibit harassment, bullying, and discrimination related to gender identity and gender expression is a crucial first step. However, creating truly supportive environments requires schools to go beyond reactive steps to proactive and pervasive changes at all levels of education and across all aspects of schooling. Sonia Nieto and Patty Bode (2008) point out that multicultural education should be a basic and pervasive part of the curricula and for all students—not only those in marginalized groups. Similarly, gender diversity should not only be addressed when issues of harassment arise, when a student undergoes a gender transition, or when administrators, teachers, and staff become aware that transgender or gender-nonconforming students attend a particular school. Instead, gender-complex education (Rands, 2009), or education that takes into consideration the existence and experiences of transgender and gender-nonconforming people, should also be seen as a basic and pervasive aspect of the curricula and for students of all gender identities and presentations. As Julie Luecke (2011, p. 117) points out, "All children need curricular mirrors to see themselves reflected and thus feel safe in being themselves, and they also need curricular windows to feel safe with the differences of others."

For gender-complex education to become pervasive, it must be infused within every content area, including mathematics. Mathematics has traditionally been viewed as a purely cognitive domain which lies outside of the social realm. As Ubiratan D'Ambrosio (1999, p. 48) observes, "During the first half of [the 20th century]... mathematics and mathematics teaching were considered to be independent of the sociocultural context." Many mathematics educators see issues of social justice as "out of their hands" (Stemhagen, 2006, p. 1). In the past quarter century, however, a growing number of mathematics teachers have acknowledged the social nature of mathematics education. Paola Valero and Robyn Zevenbergen (2004, p. 2) have described shifts toward sociological and critical perspectives that see mathematics and mathematics education as "historically constituted in complex systems of action and meaning in the intermesh of multiple contexts such as the classroom, the school, the community, the nation and even the globalized world." Rochelle Gutiérrez (2002, pp. 150–151) contrasts "dominant" and "critical" mathematics: dominant mathematics is "mathematics that reflects the status quo in society," whereas critical mathematics is "mathematics that squarely acknowledges students as members of a society rife with issues of power and domination." Eric Gutstein (2006, p. 11) calls for a "reconceptualization of the purpose of mathematics education," which would envision "the purpose of mathematical literacy as critical literacy for the purpose of transforming society, in its entirety, from the bottom up toward equity and justice, for all students whether from dominant or oppressed groups." Building on the work of theorist Paulo Freire, Gutstein developed a framework for teaching mathematics in which "mathematics is used as a tool to identify, investigate, and take action on social justice issues" (Esmonde, 2010, p.19). Gutstein (2006) and other scholars (Gutstein & Peterson, 2005; Turner, Gutiérrez, Simic-Muller, & Diez-Palomar, 2009) have suggested numerous classroom projects and lessons that use mathematics to challenge various forms of oppression. Although several mathematics educators have developed lessons that address sexism (Kitchen & Lear, 2000; Stocker, 2007), the literature is devoid of mathematics lessons and projects addressing the oppression of transgender and gender-nonconforming people.

This article proposes that "reading and writing the world through mathematics" can be one part of a gender-complex education. The article first presents background information on gender-complex education (Rands, 2009) and teaching math for social justice (Gutstein, 2006) and then suggests a specific mathematics project designed for sixth or seventh graders. In this project, students engage with data from the 2007 and 2009 *National School Climate Survey* (Kosciw, Diaz, & Greytak, 2008; Kosciw, Greytak, Diaz, & Bartkiewicz, 2010) of the Gay, Lesbian, and Straight Education Network (GLSEN) to examine how often the participants reported that a student intervened when another student made negative remarks about someone's gender expression. Through exploring this data, students learn proportional reasoning and statistical concepts. Students then develop their own school survey and formulate an action plan for increasing the frequency of student interventions in response to negative remarks about gender expression. Encouraging students to intervene is crucial, because verbal harassment often takes place when adults are not present (Kosciw et al., 2008, 2010). Students can use mathematics as a tool for working toward social justice within a broader, gender-complex educational framework.

GENDER-COMPLEX EDUCATION

Students are taught a great deal about gender in school, even when this is not an explicit intention of educators, and this learning can either reproduce or challenge gender norms. Previously, I have described four forms of gender education (Rands, 2009): gender-stereotyped education, gender-blind education, gender-sensitive education, and gender-complex education. In gender-stereotyped education, all students are assumed to fit into a dichotomous classification of gender. These gender categories are viewed as rigid and are assumed to align with genitalia (Bornstein, 1994). Teachers assume that girls and boys are essentially different and make stereotyped assumptions about the competencies, traits, and behaviors that members of each category will exhibit.

Gender-blind education developed as a way to challenge oppressive practices in gender-stereotyped education. In this form of education, teachers assume that gender can and should be ignored in educational situations. Presumably, if teachers ignore gender, then girls and boys will have the same experiences in school settings and receive equitable educations. Barbara Houston (1985/1994) critiqued gender-free or gender-blind approaches, pointing out that students do not enter schools as blank slates but bring gendered ideas with them into the classroom. Even if a teacher randomly assigns students to coed sports teams, for example, they may still interact with one another following stereotypical gender patterns on the field or court. Another critique of the gender-blind approach parallels critiques of color-blind perspectives. As Indigo Esmonde (2011, p. 30) notes, "Just as ignoring race can prevent educators from discussing inequities based on race (Pollock, 2004), ignoring gender hides the fact that gender is part of the foundation of the cultural houses [Varenne & McDermott, 1998; Boaler, 2002] we inhabit." Moreover, the extent to which gender is ignored in gender-blind education usually does not extend to ignoring the gender binary itself; students are still assumed to fit into dichotomous gender categories, which are assumed to align with genitalia (Bornstein, 2004).

Houston (1985/1994) conceptualized gender-sensitive education, in which teachers address gender issues to counteract gender bias and further equality. In gender-sensitive education, educators constantly question the ways in which gender is functioning in a situation and reflect on the interaction between gender and educational practices. Houston (1985/1994, p. 131) prompts teachers to ask, "Is gender operative here? How is gender operative? What other effects do our strategies for eliminating gender bias have?" According to Houston (1985/1994, p. 131), rather than a "blueprint for education that will answer all our questions about particular practices," gender-sensitive education "constantly reminds us to question the ways in which students and teachers make sense of and respond to sexist culture."

While gender-sensitive education provides a more nuanced and "higher order" (Houston, 1985/1994) perspective, it still maintains the problematic underlying assumption that gender is a dichotomous construct consisting of two mutually exclusive and exhaustive categories directly aligned with anatomy. Belying this dichotomous view of gender, Genny Beemyn and Sue Rankin (2011) found that among the 3,474 transgender and gender-nonconforming adults in their study, participants self-identified using more than 100 different descriptors for gender. Gender clearly cannot be reduced to a binary nor encompassed by simply adding a third delineated category for "transgender."

Gender-complex education maintains the questioning stance toward gender proposed by Houston (1985/1994) but moves beyond a dichotomous view of gender to incorporate a more complex lexicon of gender and a more nuanced framework for understanding gender privilege and oppression. In practice, taking a gender-complex approach to education involves teaching children gender-complex vocabulary and pronoun options, holding class discussions that address power dynamics using a gender-complex framework, acknowledging and respecting the gender diversity of students, and including representations of transgender, gender fluid, bigender, and other gender-nonconforming people across the curriculum. More specifically, gender-complex mathematics education might involve examining gendered images in math resources, rewriting story/word problems to increase gender diversity, and using math to investigate issues of gender privilege and oppression (Rands, 2012). Gutstein's (2006) ideas about "reading and writing the world through mathematics" provide a useful framework for conceptualizing lessons and projects that address both gender privilege and oppression, as well as other intersecting forms of privilege and oppression.

TEACHING MATH FOR SOCIAL JUSTICE: READING AND WRITING THE WORLD THROUGH MATHEMATICS

Building on Freire's idea of problem-posing pedagogy in the context of literacy education, a number of mathematics educators have applied the ideas to mathematics education (Frankenstein, 1990, 2005; Frankenstein & Powell, 1994; Gerdes, 1975, 1982; Lesser & Blake, 2007). Eric Gutstein (2006) uses the most extensive Freirean framework in his book *Reading and Writing the World With Mathematics: Toward a Pedagogy for Social Justice*. According to Gutstein, reconceptualizing the purpose of mathematics education has the ability to do much more than establish equity within the mathematics classroom; it can lead to mathematics becoming a site for the transformation of society. Paulo Freire and Donald Macedo (1987) linked the concept of textual literacy, or "reading the word," to the broader goal of learning to "read the world," or coming to understand the social, political, cultural, and historical conditions of one's life. Applying this idea in the context of mathematics education, Gutstein (2003) calls for mathematics educators and students to use,

> mathematics to understand relations of power, resource inequities, and disparate opportunities between different social groups to understand explicit discrimination based on race, class, gender, language, and other differences . . . dissect and deconstruct media and other forms of representation . . . [and] use mathematics to examine these various phenomena both in one's immediate life and in the broader social world. (p. 45)

"Reading" the world with mathematics is the first aspect of Freire's vision in mathematics education; the second aspect entails "writing" the world through mathematics—what Gutstein (2006, p. 27) refers to as "using mathematics to change the world." Gutstein (2006, p. 41) "read and wrote the world" with a group of middle school students, most of whom identified as Mexican or Mexican American, in the Chicago area through "real world projects and related conversations." In one project with a seventh-grade class, titled

Mortgage Loans: Is Racism a Factor?, Gutstein introduced the project to the class by "discussing whose families owned homes (often in extended family relationships) and whose families wanted to (everyone else)" (p. 60). In the discussion, many students talked about the challenges their families had faced in securing mortgages. Gutstein used an article from the *Chicago Tribune* which presented data on mortgage rejection rates for people of different races locally and nationally and which raised the issue of whether the data indicated institutional racism. He posed the following problem to his students: "Write a good essay answering the following question (you *must* use data from the article . . .): Is racism a factor in getting mortgages in the Chicago area?" (p. 57). Gutstein pushed students to justify their arguments by "mathematically dissect[ing] the issues" (p. 60). He also prompted them to question their assumptions and required them to revise their essays—practices which "created conditions for students to grapple genuinely for understanding" (p. 61). In the process of this "grappling," Gutstein observed growth in students' understanding of mathematics concepts, as well as in their "collective sense of justice" (p. 61).

A number of aspects of Gutstein's (2006) project are important to consider when developing mathematics projects designed to challenge the oppression of transgender and gender-nonconforming people. First, the problem came from students' lived experiences and was situated as "our problem," rather than the problem of "others." In introducing a mathematics project that addresses gender issues, it is important to acknowledge that gender privilege and oppression affect everyone. The "gender oppression matrix" serves to regulate behavior by using constraints and punishments to keep individuals from "crossing the line" in any particular situation. For example, a parent of a 12-year-old boy who was a competitive ballroom dancer filed a lawsuit because of the physical and verbal abuse directed at him. In this situation, "ballroom dancing" was perceived by the boy's peers as inappropriate male behavior (despite heteronormative assumptions, which typically require ballroom dancing partners to include one boy/man and one girl/woman). Although the boy did not identify as transgender, he still faced oppression for transgressing gender norms. Challenging transphobia and gender oppression thus benefits people of all gender identities and presentations and is relevant for all mathematics classes.

Another important point made by Gutstein's work is that mathematical understandings alone are insufficient. Introducing a mathematics project addressing transphobia and gender oppression without building background knowledge outside of mathematics risks superficial treatment of complex phenomena, or even reinforcing the oppression which the project intends to combat. Instead, it is important to situate the mathematics project within a broader cross-curricular, gender-complex approach to education. Ideally, middle school teachers can collaborate across content areas so that students can use not only mathematics as a way to "read and write the world" but disciplinary perspectives from social studies and language arts as well. The teaming model often used in middle schools provides opportunities for coordinating social justice projects and investigations across the curriculum. While exploring possibilities in content areas other than mathematics is beyond the scope of this article, middle school teams might begin by considering the resources available from organizations such as GLSEN (http://www.glsen.org/cgi-bin/iowa/chapter/home/index.html), TransYouth Family Allies (http://www.imatyfa.org/educators/index.html), and Gender Spectrum (http://www.genderspectrum.org).

Finally, while a mathematics project addressing transphobia and gender oppression necessitates building background knowledge beyond mathematics, it is also crucial that the project contributes to students' development of mathematical skills. In Gutstein's (2006) project, a focus on mathematics remained central. Mathematical understanding developed alongside the development of a "collective sense of justice." Teaching mathematics for social justice requires that students not only come to understand social justice issues and work toward greater social justice but also develop deeper understandings of important concepts in mathematics so that they are able to use mathematics more effectively.

POWERFUL MATHEMATICS CENTRAL TO THE PROJECT: PROPORTIONAL THINKING AND STATISTICS CONCEPTS

Proportional reasoning is considered "one of the hallmarks of the middle grades mathematics program" (National Council of Teachers of Mathematics, 1989, p. 213). "Ratios and proportional relationships" are identified as one of five critical areas for grades six and seven in the Common Core State Standards for Mathematics (Common Core State Standards Initiative [CCSSI], n.d.). In these two grade levels, students are expected to build on their understandings of multiplicative relationships and fractions developed in grades three through five. In grade six, students are expected to connect "ratio and rate to whole number multiplication and division and [use] concepts of ratio and rate to solve problems" (CCSSI, n.d., p. 39). In seventh grade, students are expected to "extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems" (p. 46). Another of the five critical areas identified for both grades six and seven is "statistics and probability," a new focus not addressed in kindergarten through grade five. In sixth grade, students are expected to develop an "understanding of statistical variability" and "summarize and describe distributions" (p. 41). In seventh grade, students are expected to build on this knowledge by using "random sampling to draw inferences about a population" and by drawing "informal comparative inferences about two populations" (p. 47). While it is tempting to approach "ratios and proportional relationships" and "statistics and probability" as two separate curricular areas, J. Michael Shaughnessy, Matt Ciancetta, and Dan Canada (2004, p. 184) point out that "proportional reasoning is the cornerstone of statistical inference. . . . [W]e strongly recommend that teachers and curriculum developers provide many more opportunities to enhance students' proportional reasoning skills when working in a sampling environment." The rest of this section sketches the research on students' development of proportional reasoning and understanding of statistical concepts relevant for the proposed mathematics project.

The key feature of proportional reasoning is the use of multiplicative thought structures rather than additive thought structures. Two complementary processes necessary for multiplicative thought structures are unitizing and partitioning (Grobecker, 1999; Lamon, 1996; Pothier & Sawada, 1983). Unitizing involves shifting one's thinking from seeing a number of elements as separate to seeing them collectively as a composite unit. For example, a dozen eggs can be thought of as 12 individual eggs. However, when one conceptualizes them as "one dozen" eggs, one has unitized them into a new unit called "dozen." Partitioning, the act of "breaking or fracturing a whole" (Lamon, 2012, p. 172), is "an intuitive, experience-based activity that serves to anchor a child's informal knowledge about fair sharing" (Grobecker, 1999, p. 193). For example, a student may be asked to figure out how 3 people could share 36 eggs fairly. This is an example of partitive division, in which the number of groups and the total or product are known, but the amount per group is unknown. Using and partitioning both involve flexibly thinking about units, a connection supported in empirical research on children's thinking (Grobecker, 1999; Lamon, 1996, 2012; Pothier & Sawada, 1993). In multiplicative structures of thought, "the distributive property relates multiples of the same composite units where all of the relationships are considered simultaneously" (Grobecker, 1999, p. 193), which involves a second-order relationship. Proportional reasoning builds on this multiplicative relationship but goes one step further: "What differs between the simpler multiplicative structures and the more complex structures of proportional reasoning is that proportional reasoning involves an abstraction between two second-order relationships *simultaneously* rather than a relationship between two concrete objects or two directly perceivable quantities" (Grobecker, 1999, p. 193; see also Lesh, Post, and Behr, 1988; Piaget & Inhelder, 1975). Proportional reasoning requires considering the relationship between two complex systems of relationships—a complex process indeed.

Researchers have investigated students' development of proportional reasoning in different contexts and over time (Clark & Kamii, 1996; Grobecker, 1999; Hart, 1981; Horowitz, 1981; Kieren & Nelson, 1978; Kieren & Southwell, 1979; Noelting, 1980; Rupley, 1981; Tourniaire, 1984;Tourniaire & Pulos, 1985). Research indicates a learning progression in which students transition from using additive thinking in proportional situations, to using doubling (even in situations when doubling is not appropriate), to using proportional reasoning without consistent use of iterative grouping of composite units, and finally to proportional reasoning with logical groupings (Clark & Kamii, 1996; Grobecker, 1999). The overuse of doubling early in development, as well as children's use of $\frac{1}{2}$ as a category boundary (Spinillo & Bryant, 1991), indicates a central role for the number 2 as multiplier and divisor. In students' development, they tend to overgeneralize and assume that situations involving nonproportional relationships involve proportional relationships (Van Dooren, De Bock, Hessels, Janssens, & Verschaffel, 2005). As students continue to refine their understandings of different sorts of relationships, they may become more skilled in distinguishing proportional from nonproportional situations.

According to Jane Watson and Jonathan Moritz (2000, p. 44), one important goal is for students to achieve "before they leave school, a level of statistical literacy that will allow them to contribute meaningfully to social decision making based on quantitative data." Given the inundation with statistical data in our society, the ability to use, interpret, and evaluate such data is crucial. Watson and Moritz (2000, p. 64) define statistics as the "mathematical study of variation" and identify its important components as graphical and tabular representations of variation, connections between uses of measures of central tendency and measures of spread, the use of sampling techniques in data collection, and making inferences about populations on the basis of sample data. Students' thinking about each of the components has been investigated by educational researchers. The aspects most pertinent to the project proposed in this article include graphical and tabular representations, variation in data, and concepts related to sampling.

Susan Friel, Frances Curcio, and George Bright (2001, p. 145) suggest the development of "graph sense," similar to the construct of "number sense," as the gradually developing "result of one's creating graphs and using already designed graphs in a variety of problem contexts that require making sense of data." Graph sense involves recognizing the components of graphs; speaking the language of specific graphs; understanding the relationship among a table, a graph, and data; responding to different levels of questions about graphs; recognizing situations in which a particular graph is more useful than others; and being aware of one's relationship to the context of the graph.

In addition to developing graph sense, it is important for students to understand the statistical concept of variation, "the underlying change from expectation that occurs when measurements are made or events occur" (Watson, Kelly, Callingham, & Shaughnessy, 2003, p. 1). In fact, "statistics requires variation for its existence" (Watson et al., 2003, p. 1). Jane Watson, Ben Kelly, Rosemary Callingham, and J. Michael Shaughnessy (2003) describe four levels of understanding of variation in their analysis of student responses on a questionnaire. The progression of levels ranges from having acquired only the prerequisites for understanding variation, to a focus on single rather than all aspects of a situation pertinent to variation, to the ability to apply the concept of variation, and finally to the ability to provide complex justifications for reasoning about variation. Rob Torok and Jane Watson (2000) note that students' understanding of variation appears to be influenced by their understanding of proportional reasoning.

In another study that informs the project outlined in this article, Shaughnessy and colleagues (2004) examine the connection between students' proportional reasoning, understanding of variation, and understanding of sampling concepts. The researchers surveyed middle and secondary school students using a series of sampling tasks involving red and yellow candies. Survey questions asked students about their expectations in single samples and repeated samples, as well as what they would find "surprising." Few students identified variability as an issue when asked about a single sample, but began to reason about variability in response to questions about multiple samples. A surprisingly high percentage of students said that they would expect the same result every time they sample. Students tended to have a poor sense of repeated sampling situations: some students believed that a very wide range of possible outcomes would always occur; others predicted very narrow bands of outcomes; and others predicted a range which was too high or too low. Most students relied on additive and absolute frequency types of arguments rather than on proportions or relative frequencies. Shaughnessy and colleagues (2004, pp. 183–185) conclude that "students tended *not* to use the potential power of proportional reasoning in their explanations for their responses.. .. This suggests that students do not evoke connections that proportions have to sampling situations, or that they are weak proportional reasoners in general."

CHALLENGING TRANSPHOBIA AND GENDERISM THROUGH MATHEMATICS

As one part of a broader, gender-complex education approach, students can "read and write the world through mathematics" in order to work toward transforming the climate in their schools to create a supportive environment for students of all gender identities and gender expressions. In this section, I propose a project in which middle school students use proportional reasoning and statistical concepts to engage with data from GLSEN's 2007 and 2009 National School Climate Survey. GLSEN has conducted this survey every two years since 1999 to "document the experiences of lesbian, gay, bisexual, and transgender (LGBT) students in America's schools" (Kosciw et al., 2008, p. xi). Summarizing data from previous years, Joseph Kosciw and his colleagues (2008) state that,

> the majority of the students in our surveys reported being verbally harassed because of their sexual orientation or their gender expression.. ..

> Further, the results revealed that students who identified as transgender were at particular risk for victimization in school. Our previous reports have shown how experiences of harassment and assault in school can have a direct, negative bearing on student learning and academic success. (p. 4)

These data are directly relevant to middle school students; however, without developing mathematical concepts and capacities, such as proportional reasoning and an understanding of statistical concepts, the material will remain inaccessible to those most directly affected. This project focuses on responses to an item in which students reported on the frequency with which peers intervened when hearing negative remarks about gender expression. Possible responses included *always*, *most of the time*, *some of the time*, and *never*. Addressing peer responses to harassment and negative remarks in the school context is especially important because such remarks often occur in places and at times when adults are not present. Investigating data related to peer intervention provides opportunities for middle school students to identify the problematically low frequency of peer intervention and exercise their agency to change this situation. This project should be undertaken after students have developed foundational understandings related to the complexity of gender and genderism. Students should also have had experiences that facilitate proportional reasoning and have had prior experiences with graphical comprehension, data collection, and basic statistical concepts.

Launching the Investigation

The teacher can bridge students' prior learning related to gender complexity by facilitating a review discussion or by presenting material, such as a written anecdote, YouTube video, or oral narrative, in which youth discuss being harassed because of their gender expression. Students in the class can share their ideas about what they could do if they observed such harassment. The teacher can then introduce the idea that personal stories can help us understand others' experiences, but they do not give us information about the experiences of many people. For that, surveys are often developed. The teacher can then describe the National School Climate Survey, which is used to collect information about the experiences of many students across the United States. The 2009 survey was administered to 7,261 students between the ages of 13 and 21 years old. The teacher can introduce the following statements about the students who participated in that survey:

- In all, 3,580 out of 7,261 students reported that other students never intervened when a student made negative remarks about someone's gender expression.

- A total of 49.3% of students reported that other students never intervened when a student made negative remarks about someone's gender expression.
- A total of 101 more students reported that other students at least sometimes intervened than reported that other students never intervened when a student made negative remarks about someone's gender expression.
- For every student who reported that other students sometimes intervened, there was also s student who reported that other students never intervened when a student made negative remarks about someone's gender expression.
- Based on the survey data, we would expect about 100 students in a school of 200 students to report that other students never intervened when a student made negative remarks about someone's gender expression.

Note that these statements, which are based on the actual survey data as reported in Kosciw and colleagues (2010), allow students to use the "half" boundary in this first engagement with the data. With partners, in small groups, or as a whole class, the students can discuss how they would interpret each of the statements. Questions to pose might include the following: What does each statement mean? Which statements seem easiest to understand? How can we explain that all of these statements came from the same set of data? What role do you think estimation played in developing these statements? How are the statements similar and different? How might we construct different graphs to capture what each of the statements expresses? What types of choices do we have to make in constructing the graphs? How do the graphs help us understand the statements? What is similar and different about how the graphs communicate messages about the data? Through this class discussion, the teacher can also prompt students to identify which statements use an additive model and which use multiplicative models, and press students to explain how these different models influence the message communicated about the data.

Finally, the teacher can pose this question: What if we wanted to expand the research, and we surveyed one million students from around the world? How many students would you expect to report that other students never intervened in response to negative remarks about someone's gender expression?" This question is designed to encourage students to consider the idea of sampling. The teacher can facilitate the discussion to prompt students to think about the need for representative samples (a sample of students from only the United States is unlikely to be representative of students from around the world) and the effect of sample size. Depending on students' responses in the discussion, the teacher might want to follow up with sampling activities similar to those in the research of Shaughnessy and colleagues (2004) and then return to the discussion of sampling in the GLSEN survey study.

Expanding the Investigation

First Elaboration

To expand the investigation, students can explore the data broken down by response (*never*, *some of the time*, *most of the time*, and *always*) (see Kosciw et al., 2010, p. 20). These responses could be referred to as *intervention never*, *intervention some of the time*, *intervention most of the time*, and *intervention always* to avoid cumbersome, lengthy phrases. The teacher can prompt students to generate statements from the data similar to those presented during the launching of the investigation. Examples of possible statements using multiplicative relationships include the following:

- For every 12 students reporting *intervention always*, there were 61 students reporting *intervention some of the time*.
- More than 7 times as many students reported *intervention some of the time* as reported *intervention most of the time*.
- More than 12 times as many students reported *intervention some of the time or never* as reported *intervention most of the time or always*.
- For every student who reported *intervention most of the time or always*, there were about 13 students who reported *intervention some of the time or never*.
- About 41 times as many students reported *intervention never* as reported *intervention always*.

The class can then sort the statements into those which reflect additive relationships and those which reflect multiplicative structures. The class can also discuss what new insights into the data they have gained by looking at the data disaggregated by response. Once the class has come to a consensus that the data indicate students rarely intervene when another student makes negative remarks about someone's gender expression, the teacher can pose the question: Which statements best communicate that students tend not to intervene?

Second Elaboration

After exploring the data from the 2009 survey in more depth, the teacher can share with the students that the same survey was conducted in 2007. The class can generate ideas about what they wonder about the 2007 survey data. One area of exploration would involve comparing the survey data from 2007 and 2009. An inquiry question might be: Were students more likely to intervene in 2007 or 2009? This question requires students to consider sampling issues, compare data sets, and draw conclusions about similarities and differences in the data. It also prompts students to consider whether to use an additive model or multiplicative model when examining the differences between the two sets of data. Class discussions can prompt students to see the value in using rates of change (a multiplicative model), rather than absolute differences, to make these comparisons.

Third Elaboration

Now that students have thoroughly explored the data about peer intervention rates from both the 2007 and 2009 National School Climate Survey, they can expand the investigation and apply their insights about sampling by designing and conducting a similar survey at their own school. Students must decide whether they will use a census model, in which they attempt to survey every student in the school, or choose a representative sample. If they opt for a sample, they will need to decide how to make the sample representative of the student population (all students attending the school). The students will also need to consider the size of their sample. It is hoped that experiences with other sampling tasks, such as ones with drawing multiple samples of candies, have led students to recognize the desirability of using a larger sample.

Once students have collected data from students at their school, they can analyze it and formulate statements reflecting multiplicative relationships. The teacher can also ask students to compare their findings at their school with what might be expected based on the GLSEN survey data. Given the sample size in the 2009 survey and the sample size in the class's sample, students can use proportional reasoning to find out how many students would be expected to provide each of the responses, if the ratios among responses were the same in both samples. The teacher can encourage students to make connections between proportional reasoning and sampling by prompting them to consider what would happen if they could repeatedly collect responses from their sample. Finally, students can make decisions about which statements and which graphical representations best explain their data.

Taking Action

Students can formulate an action plan based on the data they have collected about peer intervention rates in response to negative remarks about someone's gender expression. Different students groups will develop different courses of action. They may decide to create posters or flyers communicating their survey results, plan transgender-focused events (such as an activity for the Transgender Day of Remembrance), develop workshops about gender complexity, or invite speakers from local transgender community groups. They may also develop other creative, surprising, and innovative ideas that cannot be anticipated in advance.

DISCUSSION

Teachers and students are likely to gain numerous benefits, but also encounter challenges, in implementing the proposed project. Two main, interrelated obstacles that may arise are resistance from others and time and curricular pressures. Teachers and students engaged in the project may encounter resistance from a number of constituencies, including other students, other teachers, administrators, family members, community members, district-level administrators, and/or school board members. Several different opposing arguments can be anticipated. First, some opponents may argue that schools are and should be apolitical and that the proposed project is too political. This argument fails to recognize that schools are always political and that maintaining an oppressive status quo is just as much of a political stance as is challenging it. Framing schools as spaces in which it is important to "avoid controversial issues" is a hegemonic move to maintain the privilege of certain groups in schools.

A second, related argument is that the issues addressed in the project are not "appropriate" for school and should be left for parents to discuss with their children. This argument frames gender as a private, rather than public, issue to be addressed by families. However, by suggesting that teachers and students should not examine genderism, this argument implicitly condones gender-based harassment in schools. No matter how gender is discussed at home, the school community has a responsibility to protect all students from harassment. Similarly, some opponents may use homophobic arguments that connect gender nonconformity with sexuality. Again, the school community has a responsibility to protect all students from harassment, irrespective of individual beliefs about gender and sexuality. Furthermore, the project has the potential to support students in developing deeper understandings of the complexity of gender and the ways in which the concept of gender differs from that of sexuality.

In addition, some opponents may ask teachers not to engage students in the project because they fear that it will prompt discussions in other contexts (e.g., in other classes or at home), for which some people may feel unprepared. Luecke's (2011) study of how a particular school supported a transitioning elementary school student provides insights related to this argument:

> Ensuring that the intervention was school-wide by addressing the entire faculty and staff at meetings was an important element . . . in working to create a climate of continued safety. "All of the faculty and staff have been made aware of what's going on, helpful ways to respond, and the fact that [hurtful language such as teasing or name-calling] really is harassment," said Gwen [a resource teacher who also facilitated the student's transition at school]. (p. 131)

The proposed project differs from Luecke's study in that there may or may not be transitioning students in the school. However, as in Luecke's study, gender-complex professional development and communication among faculty and staff may allow other teachers and staff members to feel more comfortable in gender-related conversations. Similarly, family and community outreach might be a component of a broader gender-complex approach before, during, or as a result of the proposed project. Clear communication with families and community members about the ways in which the project relates to preventing harassment might also be important.

Finally, some opponents may use the gender-blind argument that completely ignoring gender will eliminate harassment and bias, and that discussing gender diversity makes harassment worse. However, the GLSEN reports clearly indicate that ignoring gender does not prevent harassment; on the contrary, the survey results indicate that a great deal of harassment related to gender expression occurs and that often no one intervenes in such instances. The lack of intervention, rather than constituting a solution, only contributes to the problem. The proposed project is designed to involve students in creating real solutions.

Since teaching mathematics for social justice entails challenging systems of privilege and oppression, resistance is an integral part of the process. According to Shoshana Felman (1995, p. 55), "Teaching in itself, teaching as such, takes place precisely only through crisis." Building on this idea, Kevin Kumashiro (2000a, p. 58) argues that antioppressive education entails learning through crisis: "Educators should expect their students to enter crisis . . . [and] need to provide a space in the curriculum for students to work through their crisis in a way that changes oppression." The suggested project in gender-complex education is proposed within the context of a broader antioppressive educational project, one that can draw on Felman's (1995) and Kumashiro's (2000a, 2000b, 2003, 2004) work on teaching and learning through crisis in order to address various forms of resistance.

Other possible obstacles involve time and curricular pressures. One concern is that the need to develop background concepts (both mathematical and gender related) may leave little time for the project itself. A related issue may be the pressure to use already adopted curriculum materials. Teachers who are expected to use only certain curricular materials may not feel that they have the latitude to engage students in the proposed project even if the concepts or the projects themselves are essentially the same. For example, adopted materials may address sampling and proportional reasoning related to survey data but use a different context, such as lunch preferences. Even if teachers are allowed to supplement adopted curriculum materials, little time may remain for the proposed project. Another related issue might be the desire to use less complex situations as models for mathematical concepts. Finally, teachers may experience internal or external pressure not to use the project based on the perception that the project is not "mathematical" enough. This may occur if mathematics and social issues are viewed as mutually exclusive. Some may assume that any mathematics project that addresses social issues "waters down" the mathematical content.

Several steps can be taken to address time and curricular obstacles. The first entails infusing gender-complex education throughout all grade levels and across all content areas. As schools more pervasively address gender diversity, students will bring to the proposed project more background knowledge and understanding of the complexity of gender, which will create space and time for depth in the investigation. A second important component to addressing curricular obstacles is continued professional development for teachers in relevant areas, including gender complexity, mathematical content, students' mathematical reasoning, and strategies for connecting mathematics and social issues. A final component is for school districts and schools to support flexible use of adopted curriculum materials. In conjunction, dedication to learning through crisis, pervasive gender-complex education, strong teacher preparation, and curricular flexibility can provide a context in which projects such as the one proposed can flourish.

While obstacles can be anticipated in implementing the project, addressing the obstacles will likely lead to many benefits. First, the project engages students in using mathematics in relevant, practical, and interesting ways. The project relates to issues middle school students regularly face. Second, the project is designed to deepen students' understanding of important mathematical concepts. Involvement in the project requires students to distinguish between additive and multiplicative thought structures, use proportional reasoning, explore statistical concepts such as variation and sampling, and develop an understanding of graphs. A third related benefit is that students will develop critical mathematical, statistical, and media literacy. The project requires students to interpret and think critically about data, a crucial skill in our data-saturated, 21st-century world. Finally, the project prompts students to go beyond merely interpreting data to using data in agentive ways. The project is designed to prompt students to see themselves as actors rather than observers of the world, develop the capacity to take individual and collective action against harmful phenomena, and understand that both action and inaction can affect the world around them. In other words, the project encourages students to develop powerful mathematical understandings as well as ethical reasoning and a collective sense of justice.

CONCLUSION

Educators need not attempt to transform the climate of middle schools alone. Through pervasive gender-complex education and projects such as the one proposed in this article, teachers can promote the agency of middle school students to participate in this transformation. As one part of gender-complex education, teaching mathematics for social justice ties students' development of mathematical understandings of important concepts and ways of reasoning to their developing sense of justice and their visions for a more just world.

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