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Abstract: *Attention to issues of social justice is becoming increasingly prominent in teacher education programs and in the field of mathematics education (e.g., White, Crespo, & Civil, 2016). Moreover, scholars have argued that instead of remaining isolated in a single course (typically the "multicultural" course), a focus on social justice must be integrated throughout teacher education programs (McDonald & Zeichner, 2009). This requires that mathematics teacher educators be prepared to address social justice in their mathematics content and methods courses. There are a variety of perspectives in the literature on social justice mathematics education (Wager & Stinson, 2012). In my work I focus on preparing teachers who can connect mathematics to real-world contexts that involve exploring, analyzing, and proposing solutions for current social and political issues (e.g., Gutstein, 2006)—which I refer to as sociopolitical mathematics teaching. By drawing on existing literature and my own experiences, I identify the knowledge bases that teachers and mathematics teacher educators must draw on in order to enact sociopolitical mathematics. I provide tools for engaging in sociopolitical mathematics teaching, discuss a concrete example from my own practice, and propose a framework for thinking about the knowledge needed for sociopolitical mathematics teaching.*

Keywords: social justice, equity, sociopolitical, mathematics teacher education

Introduction

There have been longstanding calls to address equity in mathematics education—for instance the National Council of Teachers of Mathematics' (NCTM's) 19 95 *Assessment Standards for School Mathematics* included a strand on equity. Moreover, the focus on equity has become increasingly prominent in the field of mathematics education, and mathematics teacher education in particular. There has been a growing focus on both the mathematics classroom (e.g., González, Moll, & Amanti, 2005; Gutstein, 2006; Leonard, 2008) and teacher preparation and professional development (e.g., Felton-Koestler, Simic-Muller, & Menéndez, 2017; Jacobsen, Mistele, & Sriraman, 2012; Wager & Stinson, 2012; White et al., 2016). In

addition, teacher education programs frequently claim to include an emphasis on social justice. However, scholars have argued that these attempts will fall flat unless social justice perspectives are integrated throughout teacher preparation programs and not relegated to a single course (McDonald & Zeichner, 2009).

Reflecting the growing focus on equity in general, and in mathematics education in particular, equity has begun to feature more prominently in mathematics education professional organizations and policy documents (Larson, 2016; National Council of Supervisors of Mathematics & TODOS: Mathematics for ALL, 2016; National Council of Teachers of Mathematics, 2000, 2014; Salerno, Herber Goins, Harron, Katz, & Leyva, n.d.). Most recently, and most relevant for this paper, the Association of Mathematics Teacher Educators (AMTE) released the *Standards for Preparing Teachers of Mathematics*, which began with the assumption that "ensuring the success of each and every learner requires a deep, integrated focus on equity in every program that prepares teachers of mathematics" (2017, p. 1) and argued "that equity must be both addressed in its own right and embedded within every standard" (p. 1).

The growing emphasis on attending to equity in mathematics teacher preparation requires that mathematics teacher educators (MTEs) be knowledgeable of equity and how to address it in mathematics content and methods courses. In the sections that follow I first discuss a range of perspectives on equitable mathematics teaching. While all of these perspectives are important, in this paper I focus on connecting mathematics to real-world social and political issues. Next, I consider the value of mathematical modeling as one avenue for addressing social and political issues. I then share an example activity for early and middle childhood prospective teachers (PTs). Finally, I draw on this example to propose a framework for thinking about the knowledge and practices MTEs need to support this form of mathematics teaching.

Defining Equitable Mathematics

There are a range of perspectives in the literature about equity, diversity, and social justice and how they relate to mathematics education (Gates & Jorgensen (Zevenbergen), 2009; Jacobsen et al., 2012; Wager & Stinson, 2012). I use the term *equitable mathematics (teaching)* to refer to the broad body of work concerned with these issues. While there are many ways to parse this body of work, here I consider the following perspectives: (1) providing access to rich mathematics, (2) recognizing mathematics as a cultural activity, and (3) using mathematics to investigate sociopolitical issues. It is beyond the scope of this paper to address all three perspectives in depth; therefore, I provide a brief overview of them and include a summary of helpful resources for MTEs (see Figure 1). In the remainder of the paper I elaborate on the third perspective (using mathematics to investigate sociopolitical issues) by providing an example lesson and exploring the knowledge required for teaching mathematics in this way.

Providing Access to Rich Mathematics

There is general agreement that all learners need access to high-quality mathematics. This often takes the form of engaging learners in problem solving, focusing on conceptual understanding, and using cognitively demanding tasks (Carpenter, Fennema, Levi, Franke, & Empson, 2000; J. Kilpatrick, Martin, & Schifter, 2003; National Council of Teachers of Mathematics, 2014; National Research Council, 2001; Stein, Grover, & Henningsen, 1996). While a problem-solving approach to teaching frames mathematics as something that all learners are capable of making sense of and contributing to, there is evidence that without thoughtful implementation it may not work equally well for all students (Lubienski, 2002). One approach to addressing this is Complex Instruction, which involves specific strategies for ensuring that *all* learners are challenged by, engaged in, and seen as contributing to high-quality mathematics in

the classroom (Cohen & Lotan, 2014; Featherstone et al., 2011; Horn, 2012; Watanabe, 2012). Importantly, Complex Instruction goes beyond providing greater access to mathematics in that it also teaches students to collaborate, communicate effectively, and value the contributions of their peers across differences in race/ethnicity, gender, and social class (Boaler, 2008). Other work focused on ensuring access for all students may include research on how to support specific groups such as English Leaners (Ramirez & Celedon-Pattichis, 2012) or students with exceptionalities (Fennel, 2011).

I view increasing access to high-quality mathematics as a central component to equitable mathematics. However, it is also important to recognize that these approaches do not critique or challenge the mathematics curriculum. Instead, these approaches remain focused on providing access to what Gutiérrez (2007) refers to as *dominant* mathematics—"the mathematics that reflects the status quo in society" (p. 39). This is the mathematics typically found in school standards, like the *Common Core* (Common Core State Standards Initiative [CCSSI], 2010), and that is required for passing gatekeeping assessments and gaining access to college and mathematics-oriented professions. The next two perspectives involve reimagining the mathematics curriculum to better integrate learners' lived experiences and sociopolitical issues.

Recognizing Mathematics as a Cultural Activity

Mathematics is often viewed as "universal" and "acultural." However, scholars have identified important ways in which mathematics is a cultural practice. Within these perspectives, one line of work focuses primarily on how we can connect mathematics to learners' lives—including their cultural identity and practices outside of the classroom. This includes recognizing and drawing on learners' *funds of knowledge*—interests, family or personal areas of expertise, community resources, etc. (Civil, 2002; Civil & Andrade, 2002; González, Andrade, Civil, &

Moll, 2001)—making mathematics teaching more culturally specific (Leonard, 2008) and connecting it to learners' lived experiences (Moses & Cobb, 2001). A second line of work, which includes studies of *ethnomathematics*, involves celebrating the many ways mathematics is and has been practiced across the globe and throughout human history. In some cases this may serve to connect to a learners' cultural identity, while in other cases it will expose learners to diverse practices (Powell & Frankenstein, 1997).

Using Mathematics to Investigate Sociopolitical Issues

Finally, the focus of this paper is on what I refer to as *sociopolitical mathematics*. This approach builds on what is often referred to as teaching mathematics for social justice (TMfSJ) or critical mathematics, in which mathematics educators engage learners in using mathematics to analyze social issues, especially those related to injustice. Examples include questioning the logic behind utility bills (Frankenstein, 1997), analyzing government spending (Gutstein, 2006), or determining how much water is needed for residents of Flint, MI in the context of an ongoing water crisis (Plumb, Roberts-Caudle, Harper, & Jones, 2017). Some perspectives on TMfSJ argue that the content must go beyond investigating issues to also include taking some form of action to address social issues and injustices. In my own work I focus on supporting PTs in developing an awareness of sociopolitical issues, broadening their perspectives about what counts as mathematics, and learning how they can engage children in sociopolitical mathematics if they so choose.

Access to Rich Mathematics	
Complex Instruction	*Designing Groupwork* (Cohen & Lotan, 2014) *Smarter Together* (Featherstone et al., 2011) *Strength in Numbers* (Horn, 2012) *"Heterogenius" Classrooms* (Watanabe, 2012)
English Learners	*Beyond Good Teaching* (Ramirez & Celedon-Pattichis, 2012)
Students with exceptionalities	*Achieving Fluency* (Fennel, 2011)
Mathematics as a Cultural Activity	
Connecting mathematics to learners' lives	*Funds of Knowledge* (González et al., 2005) *Culturally Specific Pedagogy in the Mathematics Classroom* (Leonard, 2008) *Radical Equations* (Moses & Cobb, 2001)
Multicultural mathematics	*Africa Counts* (Zaslavsky, 1999) *Math is a Verb* (Barta, Eglash, & Barkley, 2014) *The Multicultural Math Classroom* (Zaslavsky, 1996) *Ethnomathematics* (Powell & Frankenstein, 1997) *Crest of the Peacock* (Joseph, 2010)
Sociopolitical Mathematics	
Reflecting the World (Felton-Koestler et al., 2017) *Rethinking Mathematics* (Gutstein & Peterson, 2013) *Math that Matters (1 and 2)* (Stocker, 2008, 2017) *Reading and Writing the World with Mathematics* (Gutstein, 2006)	
General Resources	
Cases for Mathematics Teacher Educators (White et al., 2016) *The Impact of Identity in K-8 Mathematics* (Aguirre, Mayfield-Ingram, & Martin, 2013) "Is math politically neutral?" (Felton, 2010) "Should mathematics teacher education be politically neutral?" (Felton-Koestler & Koestler, 2017)	

Figure 1. Resources for equitable mathematics teacher education.

The Role of Mathematical Modeling

Although not a primary focus of this paper it is important to consider the role of mathematical modeling in enacting sociopolitical mathematics (Cirillo, Bartell, & Wager, 2016). Sociopolitical mathematics teaching often involves a tension between two competing goals of

learning mathematical concepts and understanding sociopolitical issues. This tension has been experienced by classroom teachers, teacher researchers, and MTEs (Bartell, 2013; Brantlinger, 2013; Felton, Simic-Muller, & Menéndez, 2012; Gregson, 2013; Gutstein, 2006; Raygoza, 2016). Mathematical modeling provides one means of addressing this tension. Mathematical modeling is the messy, iterative process of beginning with a real-world phenomenon or question, determining how to approach that topic mathematically, and then using mathematics to reach some kind of conclusion about the real-world context (Cirillo, Pelesko, Felton-Koestler, & Rubel, 2016; Consortium for Mathematics and its Applications (COMAP) & Society for Industrial and Applied Mathematics (SIAM), 2016). Modeling has gained increased visibility in the U.S. (e.g., Hirsch, 2016) with the adoption of the *Common Core*, as modeling is both one of the standards for mathematical practice and a conceptual category in the high school standards (CCSSI, 2010), and with the recent release of the *Guidelines for Assessment and Instruction in Mathematical Modeling Education* (COMAP & SIAM, 2016). Because mathematical modeling consists of solving authentic real-world problems it is well suited to addressing sociopolitical mathematics.

Classroom Example: Responding to Charlottesville

It is important to note that the following example is only one approach to sociopolitical mathematics teaching. In fact, many of my lessons are smaller and more self-contained than this example (Felton-Koestler et al., 2017). An advantage to smaller lessons is that they often allow a more narrow focus on specific mathematical concepts, while more in-depth lessons allow for an extended focus on more complex topics. Because this example is more in-depth, it is useful for illustrating the range of knowledge involved in sociopolitical mathematics teaching.

On August 11-12, 2017 there was a "Unite the Right" rally in Charlottesville, VA. While the rally was ostensibly to protest the removal of a statue of Robert E. Lee, it is better understood as an effort by White supremacists, neo-Nazis, and related far-right groups to assert themselves as a powerful voice in the political sphere ("Charlottesville: Race and Terror," 2017). Counter-protesters opposed to White supremacy organized and protested in response. On the second day of the protests, a man drove his vehicle into a crowd of counter-protesters, injuring a number of people and killing Heather Heyer (Caron, 2017). President Trump responded to the rally with statements that included "I think there's blame on both sides" and the view that there are "very fine people on both sides"—which seemed to position White supremacists and counter-protesters as morally equivalent (Thrush & Haberman, 2017).

My semester that year started on August 28 and I felt I had to respond in some way to these events in my two mathematics methods courses—one of which was for early childhood majors (preK-3) and the other of which was for middle childhood majors (4-9). Both courses were three credits and met for three hours, once a week, for 15 weeks. Although I did not collect demographic data, I would identify PTs in both classes as predominantly White women, many of whom grew up in suburban settings in Ohio. As with past semesters, the vast majority of PTs had not experienced sociopolitical approaches to mathematics prior to my course. PTs in our program do take a general course on critical studies and some of them take it prior to my course. Before the semester started, I designed a series of activities that I felt spoke to the events in Charlottesville. The lesson stretched out over the first two weeks of my course (approximately five hours total). Although the lesson began with Charlottesville, it shifted to exploring the public's views on issues of race and racism in society and then to examining segregation in U.S. schools as an example of institutional racism.

In the past I have also taught mathematics content courses specifically designed for PTs. In both courses I spend the majority of time engaging the PTs in rich mathematical tasks, so they have meaningful examples to draw from in their own teaching. However, in methods courses I devote more time to discussing classroom examples of teaching and to discussion about whether and how the PTs might use or adapt tasks for use with children. If I were to teach this lesson in a content course the mathematical content would be quite similar, but there would likely be less emphasis on establishing a safe classroom climate (see Day One and Homework below).

Day One

To start the lesson I had my students read "A Response to Charlottesville" from the National Council of Teachers of Mathematics (NCTM) (Larson & Berry, 2017). We then briefly discussed what they already knew about Charlottesville and what they felt it had to do with them as future educators, and I provided some background information on the events (much like the introductory paragraph above). Next, I differentiated between individual racism—which includes bias, stereotyping, and individual acts of discrimination—and institutional and structural racism—which includes laws, policies, practices, and cultural norms that (intentionally or unintentionally) benefit White people (Race & Social Justice Initiative, n.d.).

Analyzing data on the public's views. Next I gave my students a handout with four graphs showing differences in (a) White and Black people's views about how far our country has come in addressing equal rights, (b) White and Black police officer's views on this topic, (c) perceptions of White and Black respondents about whether Black people are treated less fairly than White people, and (d) median income by race from 1967 to 2014 (Morin, Parker, Stepler, & Mercer, 2017; "On views of race and inequality, Blacks and Whites are worlds apart," 2016). The students were asked to complete a handout for each graph with questions like, "What do you

see in the graph? What is your reaction? What do you think might cause this? What questions do you have?" This was followed with a class discussion about the question, "What mathematics did you engage in?"

Creating an inclusive classroom. Following the analysis of the graphs, we took a 30 minute break, during which time the students had to read three short pieces on the importance of creating an inclusive classroom environment (Pollock, 2017; Teaching Tolerance, 2017, pp. 17–19; "The first days of school," 2012). Finally, we discussed these articles and I then recalled the focus on institutional racism, saying that next time we would consider one example of institutional racism in the U.S.: racial segregation of schools. The students then filled out the first two columns of a KWL (Know, Wonder, Learn) chart about school segregation.

Homework

Before the next class students were required to read some background information about inclusive and socially just classrooms (Tanenbaum, 2015; Teaching Tolerance, n.d., sec. Go Deeper (3rd) video interview, 2016) as well as two articles about increasing school segregation on the 60th anniversary of the *Brown v. Board* supreme court case ("60 years after 'Brown,' same-race schools remain," 2014; Breslow, 2014). Due to differences in the timing of the courses, I only had the early childhood PTs post an online response to the readings about *Brown*. The vast majority of these students were surprised to learn that racial segregation was an ongoing (and worsening) problem:

> This article left me very surprised that I didn't know some of these facts about segregation.
> I feel like I was sort of blind from this information that there still is segregation [in] school and that it is regressing rather than progressing.
> I guess I had always thought that segregation in schools was simply no longer an issue, but I suppose I was wrong!

Day 2

When we came back together I provided some brief background on *Brown* and on the subsequent Supreme Court case *Brown II* decided in 1955. While nearly all of my students had heard of *Brown*, they were not familiar with *Brown II*, which ruled that school districts must integrate "with all deliberate speed." This wording is seen as having largely undermined the *Brown* ruling, by not requiring a specific or immediate timeline to end segregation (Ladson-Billings, 2004). Next we began the central mathematical task of the lesson, which was to explore the rates of segregation at several Cincinnati, OH schools. I had found demographic data for these schools from the Ohio Department of Education's website (Ohio Department of Education, n.d.). I "cleaned" the data provided so it fell into four categories that were most populous in the district: Black, non-Hispanic; Hispanic; White, non-Hispanic; and Other[1]. I then selected four schools to analyze: one that most closely represented the demographics of the overall district and one each that had the highest percentage of each of the three named racial/ethnic groups listed (Black, Hispanic, and White).

My two classes received slightly different versions of the task. In the early childhood class I gave them the numbers as percentages, assigned each group a particular school to focus on, and asked them to develop a graphical representation to compare their school with the overall district. We then shared representations, discussed what they showed, and discussed the advantages and disadvantages of each representation. In the middle childhood class I gave them the actual numbers of students and asked them to develop some measure of how segregated each of the four schools is and to develop a general method the district could use to measure the level

[1] This erases some groups that were present in the original dataset, including: Asian, Pacific Islander, American Indian or Alaskan Native, and Multiracial. It was difficult to decide whether to include all groups, which I felt would make the task significantly harder as the data would be more complex, or to exclude them to make the task more mathematically accessible. I remain uncertain about whether I made the right choice.

of segregation of other schools. We then discussed their approaches, reactions to the data, and how social scientists generally use more general methods of measuring segregation that do not change based on the demographics of the school district.

The lesson concluded with some final discussion about how this applies to them as future teachers, what they learned, and how I moved from Charlottesville to school segregation and how there were advantages to this—that I could create a mathematics task and explore an example of institutional racism—but also disadvantages—for example that nuances of the Charlottesville protests were glossed over. Students then filled out the rest of their KWL charts and responded to a prompt about what messages these tasks communicate about doing mathematics. Some of their comments included,

> That math is more than solving number sentences. It should be used to solve and look at everyday issues and data in the world around us.
> Math can mean more when using real, important data.
> Math is important in order to be an informed citizen.

Knowledge for Sociopolitical Mathematics Teaching

Much of the knowledge and skills highlighted in the example above are similar to the knowledge classroom teachers need to draw on if they want to engage in sociopolitical mathematics. While there has been some research and theorizing about these knowledge-bases and how they develop (especially for teachers, as opposed to teacher educators) (Ensign, 2005; Felton-Koestler, 2017; Gutstein, 2006; Turner et al., 2012), more work is needed to better understand the specific knowledge needed for sociopolitical mathematics teaching and teacher education.

To this end, I propose a framework for understanding the Knowledge for Sociopolitical Mathematics Teaching (KSMT, Figure 2). While this framework is informed by existing literature, it is also grounded in my own experiences with sociopolitical mathematics teacher

education. The KSMT framework highlights the importance of building a socio-politically-oriented community. It also illustrates how (1) Knowledge of Sociopolitical Issues, (2) Knowledge of Sociopolitical Curriculum, and (3) Mathematical Knowledge for Teaching (MKT) (Ball, Thames, & Phelps, 2008; Castro Superfine, Prasad, Welder, Olanoff, & Eubanks-Turner, 2020) inform Knowledge for Mathematizing Sociopolitical Issues. Because scholarship in this area is still emerging, I intend this to be a general framework for conceptualizing the knowledge needed for sociopolitical mathematics teaching at all levels (K-12 and teacher preparation), but future work should attend to differences in KSMT for classroom teachers and MTEs.

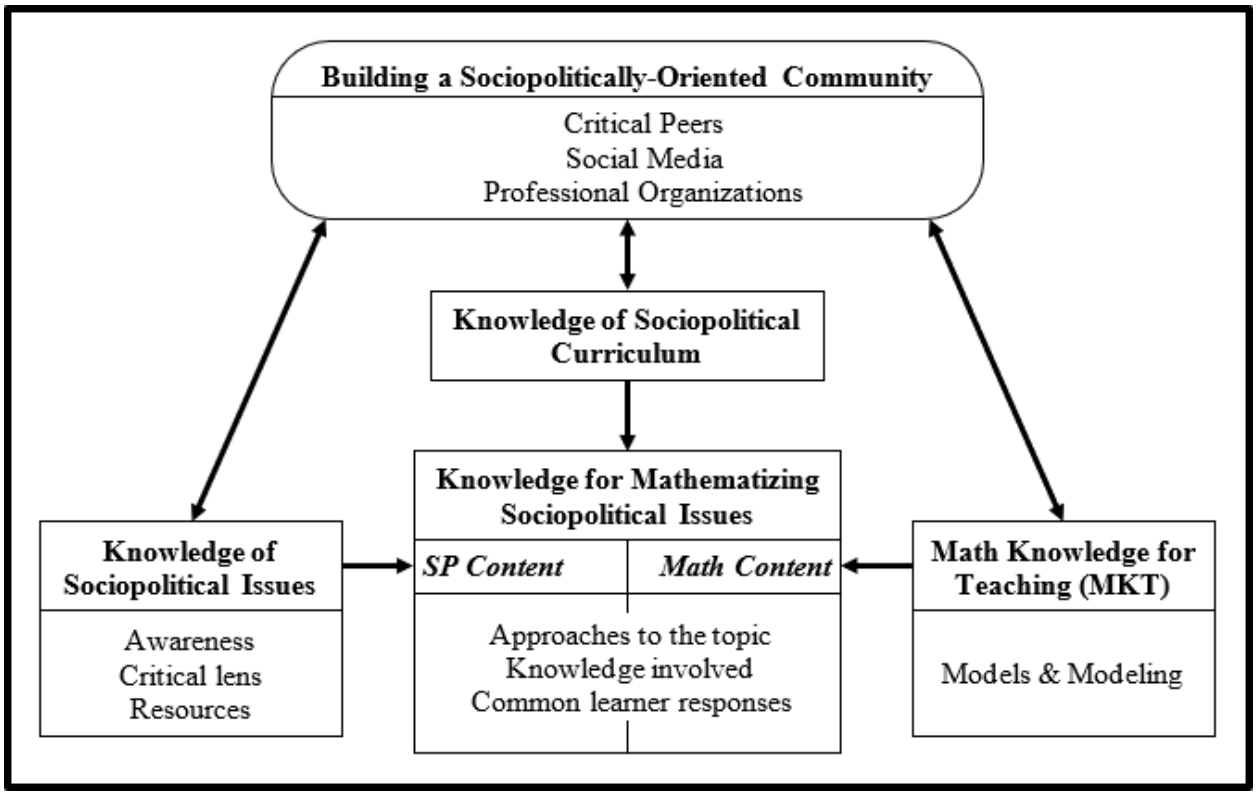

Figure 2. The knowledge for sociopolitical mathematics teaching (KSMT) framework.

Building a Sociopolitically-Oriented Community

A key practice that makes sociopolitical mathematics teaching easier to engage in is building a network of colleagues who are committed to exploring issues of equity and social justice (Picower, 2012). Suppa, DiNapoli, Thanheiser, Tobias, and Yeo (2020) highlight the importance of both mentorship and collaboration in supporting novice MTEs. Many potential collaborators may be within the field of mathematics education, but collaborating across fields can be particularly powerful for broadening one's understanding of sociopolitical issues. In developing the Charlottesville lesson, I received feedback on earlier drafts from colleagues who were both encouraging and supportive, but also pointed out possible refinements to the lesson and additional resources to use. Moreover, a colleague in my department had forwarded the Pollock (2017) article to the entire department suggesting that we consider using it as a tool for addressing the recent Charlottesville riots (C. Koestler, personal communication, August 18, 2017).

Professional organizations. Being engaged with and aware of the stance of professional organizations is of particular value, especially as these organizations have made issues of equity and social justice a more explicit component of their policy documents and statements (AMTE, 2017; Larson, 2016; National Council of Supervisors of Mathematics & TODOS: Mathematics for ALL, 2016). When working with middle grades PTs, I also draw on *This We Believe* (Association for Middle Level Education, 2010), which emphasizes interdisciplinary connections. In the context of the Charlottesville lesson, I found it easier to broach the topic by beginning with an official statement from NCTM on the topic (Larson & Berry, 2017). Documents such as these may provide some level of buffer between the MTE and the topic under investigation, so PTs and colleagues are less likely to view it as the MTE's "personal agenda."

Social media. Finally, while social media, and the often negative media cycle can be overwhelming, it can also be an excellent resource, especially in responding to more pressing current events. There were a number of materials released almost immediately after the protests in Charlottesville under #CharlottesvilleCurriculum on Twitter. There are also a number of organizations that one can follow on social media to help stay informed about current events and to help develop a critical lens in making sense of ongoing issues (Figure 3 provides an incomplete list of useful websites and online groups).

Teaching Tolerance (www.tolerance.org)

Rethinking Schools (www.rethinkingschools.org)

AMS inclusion/exclusion blog (blogs.ams.org/inclusionexclusion/)

Equity & Social Justice in Math Education (www.facebook.com/groups/178344199241717/)

Reimagining the Mathematics Classroom (www.facebook.com/groups/1031242706977095/)

STEM Equity (www.facebook.com/groups/1591495307737242/)

Math Ed Collective (mathedcollective.wordpress.com)

Figure 3. Resources for staying informed.

Knowledge of Sociopolitical Issues

Without knowledge of social and political issues, MTEs cannot engage PTs in using mathematics to explore these issues. There are several subcomponents to this body of knowledge.

Awareness. First, MTEs must be aware of both current events, like the Charlottesville protests, and ongoing issues, like school segregation, that are likely to be viewed as controversial or political in nature. Doing so requires staying informed about current events through news and

other media sources. It also involves developing a critical lens (see below) and using this lens as one way of interpreting and making sense of current events.

A critical lens. Second, MTEs must know how these issues are typically understood and framed both in general discourse and from a critical perspective. For example, this would include recognizing the Charlottesville protests as being more about the far-right asserting itself in the political realm than about a particular statue. Regarding school segregation, a critical lens would include knowledge of the fact that while segregation initially declined in the wake of the *Brown* ruling it has since increased and reflects the segregation of our schools and neighborhoods. Moreover, it would involve understanding that segregation is not "just the way it is" but instead is connected to government policies including neighborhood segregation (Ladson-Billings, 2004). A critical lens also includes recognizing the differences between individual biases and institutional and structural forms oppression. This involves knowledge of some of the most commonly studied forms of oppression (e.g., racism, classism, sexism, genderism, heteronormativity, ableism), some of the ongoing issues that emerge related to these forms of oppression (such as income inequality), and the ways in which these issues intersect and interact in complex ways.

Resources. Finally, MTEs need to know what resources there are for better exploring and understanding sociopolitical issues. This might include articles or resources for understanding the nuts and bolts of a particular context or issue under investigation (such as news articles about *Brown v. Board* of education and its lasting effects) or materials that provide learners with a range of perspectives on an issue. Perhaps most importantly, resources also include data sources and other information that can be used for investigating the topic mathematically. In the case of

school segregation, this includes knowledge that demographic data about schools is likely available, at least in some areas, and the ability to effectively seek out these data.

Knowledge of Sociopolitical Curriculum

There is a growing body of example lessons that can be used to explore social and political issues with K-12 students and PTs. These include collections of mathematics-specific lessons (Felton-Koestler et al., 2017; Gutstein & Peterson, 2013; Stocker, 2008, 2017), interdisciplinary perspectives (Schniedewind & Davidson, 2014), and reflections on the process of approaching these issues with PTs (Wager & Stinson, 2012; White et al., 2016). Some of these resources include support materials that allow them to serve as educative curricula that can support MTEs in deepening their own knowledge of the social issue and how to teach it (Suppa et al., 2020). These resources may serve as "ready-made" lessons that can be implemented in an MTE's classroom and/or they may be analyzed by PTs reflecting on using them in the classroom. In my own work, I often draw on these resources as a source of inspiration that I then modify to fit my instructional goals.

Mathematical Knowledge for Teaching (MKT)

There is a substantial body of literature on the specialized mathematical knowledge for teaching (MKT) (Ball et al., 2008) and an emerging body of work on mathematics knowledge for teaching teachers (MKTT), which is often understood to include and extend beyond MKT (Castro Superfine et al., 2020). For my purposes, I will use MKT as a blanket term to address the specialized knowledge for both teachers and MTEs. The dominant perspectives on MKT, including how it has been operationalized (Hill, Schilling, & Ball, 2004), are primarily concerned with teachers' understanding of important mathematical concepts (e.g., computational strategies) and how learners make sense of these concepts. This emphasis can also be seen in

analyses of policy, research, and curricula for PTs (Zhang, Brown, Joseph, & He, 2020). In contrast, the focus on real-world contexts in sociopolitical mathematics requires drawing on different aspects of MKT. First, MTEs must draw on knowledge of the mathematical modeling process and how to engage students in modeling (Carlson, Wickstrom, Burroughs, & Fulton, 2016; Hernández, Levy, Felton-Koestler, & Zbiek, 2016). In the Charlottesville example, the middle childhood task of developing a general measure of school segregation involved aspects of mathematical modeling. Second, MTEs must draw on a related body of knowledge about common uses of mathematics concepts, models, and techniques in real-world contexts. In the case of school segregation, this included knowing that one way in which social scientists quantify segregation is to consider how many students attend schools where the student body is predominately (90% or higher) White or students of color[2] (Orfield, Frankenberg, Ee, & Kuscera, 2014).

Knowledge for Mathematizing Sociopolitical Issues

Most central to the KSMT framework is the knowledge of how to mathematize social and political issues. For any particular topic this includes integrating sociopolitical and mathematical content. With respect to both of these subdomains of knowledge, MTEs must draw on a variety of knowledge bases.

Approaches to the topic. This includes common approaches to addressing the mathematical content, the sociopolitical issues, and how the two can be brought together. Knowledge in this area may be heavily influenced by Knowledge of Sociopolitical Curriculum, especially if there are examples of exploring this or a related topic. One's knowledge of approaches to the mathematical content (or the range of possible mathematics topics that may

[2] My use of "students of color" is not intended to communicate that "White" is not a race or color.

come into play) is largely dependent on their MKT. Similarly, Knowledge of Sociopolitical Issues will heavily influence an MTE's understanding of how the sociopolitical issue in question can be explored mathematically and pedagogically with prospective teachers. In the context of school segregation this involved the creation of task that blended (1) elementary and middle grades mathematics topics, with (2) an investigation of school segregation, the demographic makeup of a district, and possible methods for measuring segregation.

Knowledge involved. Designing and implementing sociopolitical mathematics lessons requires an understanding of both the sociopolitical and mathematical knowledge that a task is likely to evoke. In particular, it is important for MTEs to work through tasks themselves and think about the real-world and mathematical knowledge they draw on and any new knowledge learners are likely to develop through this activity.

Common learner responses. Ideally, MTEs would also have knowledge of how learners are likely to respond to the important concepts in a lesson. This includes common likely (mis)conceptions and background knowledge learners may have, whether the topic is likely to be of particular interest, and common strategies used to approach the task. With respect to the mathematical content this corresponds to the MKT domain *knowledge of content and students* (Ball et al., 2008). Regarding the sociopolitical content, this may be harder to identify, especially as there is less research on common reactions to a range of sociopolitical issues. In the school segregation example, this included my assumptions that (1) most of the PTs would have little knowledge of the current trend towards increased segregation, and (2) the mathematics of measuring segregation would be challenging but something middle grades PTs could approach using percentages, ratios, and fractions.

Challenges

Where's the Math?

Prospective teachers, colleagues, and/or administrators may question the use of sociopolitical contexts in content or methods courses (Aguirre, 2009; Felton-Koestler & Civil, 2016; Felton et al., 2012). This may especially be the case in mathematics departments where there may be strong views about what is expected in a mathematics course. I have worked in a mathematics department and a college of education and am fortunate that addressing issues of equity and social justice is explicitly valued at my current institution. Ultimately there is no easy solution to this issue and much of it depends on your local context. My primary strategy in addressing this is to emphasize connections to standards and the fact that as future professionals, PTs will have to make choices about how they address those standards. They cannot make those choices if they are not familiar with a range of techniques. I highlight the importance of real-world connections, including mathematical modeling, in the *Common Core* (CCSSI, 2010). This includes clarifying that, regardless of the real-world context selected, genuine mathematical modeling requires substantive unpacking of the context in addition to "just doing the math." I also provide my PTs with a variety of mathematical experiences, including: (a) typical problem-solving based mathematics tasks (e.g., developing an algebraic rule for a growing pattern), (b) modeling real-world contexts that are not overtly political (e.g., developing a measure of trail difficulty based on a topographical map), (c) sociopolitical tasks that involve mathematical modeling like the task presented here, and (d) sociopolitical tasks that are focused on specific mathematical concepts (e.g., introducing mean and median by analyzing income distribution). This approach allows me to ground my work in standards while also allowing for professional discretion on the part of teachers.

Aren't You Pushing an Agenda?

Sociopolitical mathematics is challenging because as educators we often have a particular interpretation of the sociopolitical issue under investigation. Although I rarely take an explicit stance in class, I have no doubt that my PTs are aware of my perspectives on the topics we discuss. However, I generally frame all of my tasks as open in that PTs are free to reach their own conclusions about the context. In the case of the Charlottesville task, many PTs reached the conclusion that high levels of school segregation were acceptable if the community itself was already segregated. Many of them referred back to their own districts saying it would not be fair to judge their districts as segregated if the district itself was predominantly White[3]. While I raised alternative perspectives, such as the fact that social scientists often use a more general measure of segregation (for instance if the school is over 90% White or students of color) and that districts themselves might be segregated as a result of other problematic social forces, it was ultimately up to the PTs to decide how to make sense of this issue.

Framing tasks as open to interpretation helps protect against, but does not completely eliminate, the accusation of "pushing an agenda." It is also important to note that I identify as, and my students position me as, a White man. Many of my colleagues who are women and/or of color often unfairly face a higher level of critique than I do.

Where do I Start?

Many MTEs feel overwhelmed by the time required to develop good sociopolitical mathematics tasks, potential pushback from students or colleagues, or the uncertainty about how to navigate challenging conversations. I suggest starting by building relationships with other likeminded colleagues, attending relevant sessions at conferences, and reading some of the

[3] While I believe this was likely to occur no matter how I framed the task, it was likely exacerbated by giving the PTs district-level demographic data to compare the four schools to.

resources shared in Figure 3. Ideally, you may also be able to identify likeminded colleagues at your own institution, which may provide some level of buffer against the idea that you are a lone rogue. In addition, I suggest starting with something small. Pick one of the resources from the sociopolitical mathematics section of Figure 1 and pick a task with which you feel comfortable. Based on my experience, topics that are positioned as "far away" (either outside the U.S. or at least outside the local context) and topics related to the environment are often viewed as less controversial by PTs, so they can be a good place to start. In addition, tasks with a clear mathematical focus are often easier to justify as "mathematics." As suggested above, framing tasks as "open for discussion" instead of requiring PTs to reach a particular conclusion is often more effective and less controversial.

Conclusion

If mathematics education is going to prepare engaged and knowledgeable citizens, then analyzing sociopolitical issues must be an integrated focus. This requires teachers and MTEs to engage in new forms of teaching and to develop different forms of knowledge. The KSMT framework (Figure 2) and the suggestions in this paper offer one starting point. While I have offered some ideas about how to start in a way that insulates you from potential attacks, this work *is* challenging. You should expect some degree of pushback from colleagues and/or PTs that will require some thoughtful navigation. However, this work can also be highly rewarding as PTs are often more engaged by realistic problem contexts and new approaches to mathematics (Aguirre, 2009; Ensign, 2005; Mistele & Spielman, 2009; Rodriguez, 2005). I view this work as planting a seed. Not all (or many) of my PTs will go on to integrate sociopolitical issues into their future teaching. However, I have provided them with a broader perspective on what

mathematics teaching can look like (Felton & Koestler, 2015) and have laid a foundation that they can build on if they decide to.

I see three areas in need of future research. First, more work must be done to better define and detail each aspect of the KSMT framework. How can we more carefully describe the components of this framework and the different knowledge bases involved in sociopolitical mathematics teaching? Are there key concepts or big ideas within each body of knowledge that are most productive for teachers and MTEs to develop? Second, in addition to developing their knowledge, how do teachers and MTEs learn to orchestrate meaningful conversations around these topics with learners? Third, are there consistent learning trajectories that PTs follow in learning to enact sociopolitical mathematics teaching? If so, how does this inform the KSMT needed for MTEs?

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