

REIMAGINING DEFINITIONS OF TEACHING MATHEMATICS FOR SOCIAL JUSTICE FOR PRESERVICE SECONDARY MATHEMATICS TEACHERS

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We investigate definitions and approaches that preservice secondary mathematics teachers develop about teaching mathematics for social justice while participating in an equity-based, anti-racist professional development program. We analyzed transcripts from seminar sessions of the program where participants discussed different forms of teaching mathematics for social justice. Participants described their possible teaching with what is seen in the literature while moving beyond in formulating other possible representations of teaching mathematics for social justice. These findings suggest that it may be necessary to further theorize our understanding of teaching mathematics for social justice so that representations include everyday practices beyond representations in curriculum.

Keywords: Teacher Education, Equity and Diversity, Teacher Knowledge, Social Justice Mathematics

Mathematics education continues to attempt to address injustices in multiple ways as we look for possible solutions through teaching mathematics for social justice. Some would argue providing all students with access to rigorous mathematics is an act of social justice (Moses et al., 1989; Gregson, 2013). Critical scholars suggest we change the curriculum, using mathematics as a tool to analyze injustices in society and to propose math-based solutions (Frankenstein, 1983, Gutstein 2005). This approach has become the dominant definition of teaching mathematics for social justice (TMSJ). It allows students to develop other life skills (e.g., questioning authority) that mastering “dominant mathematics” (Gutiérrez, 2002; Valero, 2004) does not guarantee (Bartell, 2013; Felton-Koestler, 2015; Gregson, 2013; Gutstein, 2006). However, carrying out this version requires knowledges, skills, and life experiences that many teachers lack. This paper investigates how pre-service secondary mathematics teachers (PMST) are developing their definitions and approaches to what TMSJ as they become educators in the field. Our current understanding and implementation of teaching mathematics for social justice have plateaued due to neoliberal educational values (e.g., individualized learning, privatization through charter schools, increase focus on profitizing through universal curricula models), that drive mathematics education. It is safe to say that there is a need to deeper theorize social justice in mathematics education. This paper seeks to understand the range of views of TMSJ that pre-service secondary mathematics teachers embrace after being exposed to a variety of anti-racist and social justice-oriented media and individuals.

Current Understanding of Teaching Mathematics for Social Justice

Mathematics education has a persistent history where students who are Latinx, Indigenous and Black have not had access to a rigorous mathematics curriculum thereby limiting the doors and economic possibilities that they can pursue in society. Some would argue that merely providing minoritized students access to dominant mathematics and science, technology, engineering and mathematics (STEM) pipeline is a form of social justice (Brantlinger, 2013; Felton-Koestler, 2015). The Algebra Project is one prominent example of transforming algebra curricula to create an entry point for African American students (Moses et al., 1989). Through

grassroots organizing, teachers, students, and parents established a pedagogy of mathematics that supported students to participate in economic and technological changes (Moses et al., 1989). Other researchers agree and have defined social justice as “empowerment, both for teachers and for their immigrant students” to succeed in dominant mathematics (Planas & Civil, 2009) and highlight the importance of students being able to navigate mathematics as a gatekeeper in the real-world (Gregson, 2013).

Definitions of social justice or critical mathematics vary depending on the populations that adopt them, the worldviews espoused, and situations at hand (Gates & Jorgenson, 2009; Stinson & Wager, 2012). For the most part, what gets counted as social justice mathematics teaching involves changing the curriculum (Bartell, 2013; Brantlinger 2007; Gregson, 2013; Gutstein, 2006) to take up examples of real-life situations (Felton, 2010) or to use mathematics to read the world and possibly write the world (Gutstein, 2006; Frankenstein, 1990; 1995). For example, Gutstein (2006) had his students survey the community on experiences with the police to calculate the likelihood that a police officer will pull over a brown or Black person, versus a white person, when driving a car in a given neighborhood, while Frankenstein (1990, 1995) had her low-income college students use mathematics to examine discrimination in costs of electrical power, home mortgage distribution, and the tax system to highlight how mathematics is sometimes used to obscure economic, political, and social issues. In fact, the inclusion of ethnomathematics lessons can be seen as a form of social justice curriculum (Borba, 1990; Powell & Frankenstein, 1997) because ethnomathematical knowledge decenters a Western and colonial view of mathematics (Gutiérrez, 2017).

Critical Perspectives to Teaching Mathematics for Social Justice

While creating access to dominant mathematics is essential for Black, Latinx, Indigenous and other minoritized students, as well as interrogating injustices that these communities may experience, some would also argue for critical representations of mathematics. Such representations move beyond using social justice mathematics as curriculum and disrupt dominant social narratives and representations of mathematics (Gutiérrez, 2017; Skovsmose, 1994). Teachers and students who participate in these types of critical representations of mathematics are participating in “tactics of resistance” (Gregson, 2013) of social and institutional inequities replicated in the classroom. Providing teachers with opportunities to envision “tactics of resistance” are limited within our current literature of TMSJ except for few. That is, students need to learn mathematics to participate in the neoliberal capitalist agenda in society while being able to critique it and “play the game/ change the game” (Gutiérrez, 2008).

Teacher Practices of Social Justice Mathematics

Beyond offering a sociopolitical context of mathematics units and lessons, it is difficult to see what other forms of social justice teachers can implement in their classrooms. Although there is a strong emphasis on changing the curriculum (e.g., adopting sociopolitical contexts for learning mathematics in particular activities or units), in fact, there is a range of practices that contribute to social justice mathematics teaching. One such form is pedagogy of questioning—a “classroom environment... co-created by students and teachers [where] students have opportunities to pose their own real, meaningful questions” (Gutstein, 2008, p. 55). Pedagogy of questioning is not necessarily curricular driven but allows students to see the importance of asking questions and challenge the notion that teacher knows all. Another practice is developing relationships with students (Planas & Civil, 2009; Gutstein, 2008) in non-stereotypical ways (Bartell, 2013) by being aware of students’ realities to empower their success and participation in mathematics classrooms. Empowering students includes being able to recognize the need to

address race and gender issues as institutional issues (Frankenstein, 1990; 1995). Understanding students in non-stereotypical ways are important because it pushes teachers to anticipate the types of responses that students can have in a lesson (Bartell, 2013) and support the emotions that can arise (Boylen, 2009).

While developing relationships with students and implementing pedagogy of questioning are valid representations of everyday tactics that teachers can do on a daily basis, one has to question if they are realistic in the current mathematics classroom? Research studies that address perceptions held by teachers implementing TMSJ highlight how many can get discouraged by the difficulty of implementing such lessons (Bartell, 2013) or feel it is difficult to implement while trying to keep the rigor of higher-level mathematics (Brantlinger, 2013). The increasing demand of high stakes testing presents time constraints for implementing social justice mathematics lessons, resulting in “end of the year activities”—making it seem like it is just an add-on, or afterthought, to more crucial traditional mathematics curriculum. There are limited representations of what other practices could look like. The exception to this are representations of the pedagogy of questioning (Gutstein, 2008), creating relationships with students, and challenging one’s beliefs and identities (Bartell, 2013; Boylen, 2009; Gregson, 2013; Gutstein, 2008;). These constraints limit pre-service teachers being able to become a teacher that teaches mathematics for social justice if they feel like it requires entirely or mainly changing the curriculum, something for which they may feel they have no power to do in an era of high stakes education. Furthermore, we need to ask how

Methods

Data

The data in this paper comes from an equity-based professional development program in a Midwestern University where two cohorts of undergraduate pre-service mathematics scholars (juniors and seniors) interacted. Scholars received professional development including bi-weekly seminars, mentoring sessions, a partnership with a Chicago teacher, an after-school mathematics club, and critical professional development. In seminars, scholars discussed readings/videos about issues of racism and racialization, white supremacy, gender, social justice, and mathematics; learned about mathematics in nontraditional ways; engaged with guest speakers, and interacted with alumni.

Scholars consisted of two cohorts of junior and senior scholars. Junior scholars were in the first year of the program while seniors were in their second year. Juniors consisted of six scholars, of which, three self-identify as white women, one as cis-gender Latinx man, one as Asian woman and one white man. Seniors consisted of seven scholars, one self-identifies as an Asian woman, and six as white women. Two self-identify as queer. Most of the scholars originated from the suburbs of a major Midwestern City and one originated from a rural town in a Midwestern state. All scholars received a scholarship in exchange for committing to teach in a school in a community of cumulative disinvestment for four years following graduation.

We focus upon two different 3-hour seminar sessions: “Teaching Mathematics for Social Justice (part 1 and 2).” Table 1 shows the topics and participants. Before coming to the seminar, scholars wrote a letter to Gutstein, reflecting on his teaching and their stances on TMSJ, especially what was appealing or concerning for them.

Table 1

<i>Seminar Activity Topics</i>		
Activity	Participants	Materials Covered

Day 1			
Book Discussion Part 1	Juniors	Reading and Writing the World with Mathematics	
Study of SJM Materials	Seniors	Social Justice Math Unites created by Brian Lake	
Conversation with Scholars	All	Social Justice Math Unites created by Brian Lake	
Day 2			
Book Discussion Part 2	Juniors	Reading and Writing the World with Mathematics	
	Seniors	Guide for Integrating Issues of Social and Economic Justice into Mathematics Classrooms and Curriculum	
Study of SJM Materials Questions and Stances	All	Notes and Summaries from split sessions	

Analysis of Session Audio and Materials

We placed audio recorders in multiple parts of the rooms where discussions took place. We then transcribed verbatim, focusing on the relevant conversations about social justice mathematics. We transcribed a total of 140 minutes for each of the two sessions, using codes that arose in the literature. Some of these codes include references to Social Justice Mathematics, (e.g., reading the world, writing the world, challenges, curriculum) and Classroom Norms (e.g., group work, critical thinking). Other categories such as Ethical Teacher Practices (e.g., political clarity, stance, windows/ mirrors) came from existing categories of codes that we have as a project or literature our research team has produced. During the first round of coding, we captured themes that confirmed existing trends in the literature of social justice mathematics as well as highlighted themes not captured in the literature. For example, we created the code ETP-spectrum to highlight when the scholars brought up ideas of having multiple possible stances on a sociopolitical topic represented in their classroom—a representation of teaching mathematics for social justice that Brian Lake brought up in his conversation with the scholars. During the second layer of coding, we looked for other things the scholars considered as representations of everyday social justice practices. It is important to note that the researchers never directly asked for the scholars to list their explicit definition of what they consider teaching mathematics for social justice, as we worried that they would simply tell us what they believed we wanted to hear. Instead, we looked for examples of the scholars talking about the readings or their everyday practices that reference their stances of being social justice educators who can continuously push back on dominant narratives of what happens in the classroom. We then clustered the codes into different themes that showed a representation of current definitions of teaching mathematics for social justice as well as representation of everyday practices that teachers can enact their social justice teaching stances (Emerson, Fretz, Shaw, 2011). These themes include redefining mathematics, delegating authority, and examples of teaching students to be critical participants in society. Though our scholars held definitions and stances like some found in other studies, we focus the reporting of our findings on concepts not typically or explicitly addressed in empirical studies of teachers enacting TMSJ.

Findings

TMSJ as Redefining Mathematics

One way that the scholars look at TMSJ was the way they interpreted the role of mathematics and the practices that surround mathematics. Scholars brought up multiple ways of being able to redefine mathematics. One example is making mathematics applicable across school subjects.

Catherine: I think it would be more beneficial if we actually gave them examples of how to apply it. Connect it to these types of problems that are actually happening in the

world.... Like [Mathematics] wouldn't have to be a separate thing. Schools would be better off...if we are on the same page with stuff, connect the ideas, and use what other teachers are teaching.

Catherine states that some schools and teachers treat mathematics as its own “separate thing” within the curriculum. For her, having mathematics disconnected from other subjects does not allow students to see how mathematics relates to other subjects and can be applied in solving problems in the world. TMSJ as teaching math in a holistic approach would not only benefit students but the whole school to by applying all subjects to solve problems in the world. This way of redefining mathematics would not only benefit how students learn in the classroom but also support collaboration with teachers across content areas.

For the scholars, TMSJ means redefining mathematics so that students can develop different perspectives of what is the role of mathematics in increasing opportunities for students to create and understand mathematics around them. The scholars are beginning to formulate that the role of mathematics is not only providing instrumental access to mathematics as a curriculum, but it is also teaching mathematics in a holistic approach as well as teaching students to provide a spectrum of solutions. By opening different ways of knowing mathematics and who gets to be knowers, Black, Indigenous and Latinx students can not only see themselves as having something to say but are also encouraged to develop new mathematics, a way in which students can also be authors of the world.

TMSJ as Delegating Authority

In this section our scholars talk about TMSJ as finding different ways to delegate authority in the classroom. Whether it was making decisions about curriculum or facilitating discussions, delegating authority is a way to empower students in the classroom. During the conversation of scholars one scholar brings up

Wendy: I am considering **redefining the structure of the roles of students in the classroom**...how [do we] get student-led discussions, **more student-led than teacher driven**. And then have them ask the questions first. What kinds of questions are we looking at when we are examining the social justice topic?

For Wendy, redefining the structure of the roles of students in the classroom is a social justice practice in that a teacher is giving up knowing the direction of a conversation and letting students decide where it should go. In this sense, she sees students being authors of the classroom (Povey & Burton, 1999). Wendy recognizes that there are daily things a teacher can do to empower her students in the classroom that could lead to questioning other power structures and dynamics in their lives. By disrupting power structures that exist in classrooms, scholars see the connection between social justice teaching and helping students develop the skills to interact as critical participants of society.

TMSJ is capacity as critical participants in society

The scholars are not just thinking about how students can be successful in their classroom, but also what skills they can learn and carry with them that can impact students as critical participants of society. These skills include supporting perseverance; teaching students to struggle; developing opinions and being able to express them; being able to efficiently communicate given constraints of a task; and taking responsibility of their peers as a community.

Tied to students being critical thinkers, Catherine defines TMSJ as allowing students to be confident and able to communicate their opinions. she shares one of her goals is to help students develop confidence by showing students the importance of sharing their opinions.

Catherine: Expression of **your beliefs** or kind of like you. The way you communicate your feelings... **you have to be able to develop an opinion, but also express it in a way that is true to yourself but respectful for other people involved with it as well.** [Students] have opinions and I feel like **being able to express them is pretty important component of social justice** and I feel like should be incorporated in the classroom as well.

Catherine recognizes that her students do have an opinion and being able to express it is important for her students to learn. Whether it is a student who is passionate about approaching a problem a certain way or an opinion in a current topic that impacts the students, Catherine acknowledges that students' opinions are not only connected to their beliefs but also to their emotions about these topics. She goes beyond to express how it is not enough for students to develop their opinions but to also "be true to yourself [and] also respectful for other people involved" in the conversation. Catherine wants students to develop skills that reflect the dignity that they would like to see beyond mathematics content. Traditional mathematics lessons tend to focus on the individual and do not necessarily focus on the well-being of others. Thus, developing an opinion that is both true to yourself as a student but also takes into consideration those around you in the conversation is a form social justice that goes beyond what can be used in mathematics classrooms and toward rehumanizing mathematics (Gutiérrez, 2018).

Pedagogical Moves for Implementing TMSJ Definitions

While some may feel like it is not an accomplishment to get pre-service teachers to talk theoretically about their definitions of social justice, we have evidence that our scholars enacted their definitions as student teachers. Some of the scholars even developed their own social justice lessons that incorporated exponential growth with issues of housing regulations. We do not analyze those social justice lessons here, as they tend to replicate the existing literature on TMSJ. Instead, we transition to examples of how these scholars are implementing pedagogical moves that would accompany their stances above.

Delegating Authority. As Wendy and Erica shared their working definitions of TMSJ as delegating authority and showing students their capacity to be critical participants of society, other scholars jumped into the conversation to share examples of everyday things they do in their student teaching classrooms.

Catherine: One thing I do is I will randomly, not randomly but basically **choose a student each day and I call them my teacher assistant. It starts out with having them either pass papers out or they will help me write out the example problem on the board,** or they will help me, like, having them keep the class in check. **They get really into it and** then it gets to a point where, now, **one of my students he like loves to explain.** I am trying to look over a students work he will be like " oh I will help that student, you can go and help other students". **If you let students help with classroom management,** having one student make sure that no one is purposefully hurt, **they can help with what others may not know and that student feels special and you can put them in a situation where they feel comfortable to share with the class and build their confidence.**

Catherine shares that she delegates authority in her classroom to increase students' confidence by allowing their peers see them as an expert in class. While having students help with some task that can help her get through her daily agenda, she is also trying to communicate to the chosen student that she trusts them. Setting up a buy-in for the student then allows them to transition into building their confidence to be able to help other students, i.e., build their mathematical identities. In choosing teacher assistants, Catherine shows students that they can help her with

daily tasks and also be bearers of knowledge from which other students can learn. The end goal not only helps Catherine with the daily managing in her classroom but also allows her to create impactful student leaders with positive mathematical identities.

Limitations

A limitation of our current understanding of teaching mathematics for social justice comes from theory and practice that relies on democracy (for example, Freire, 1970) which helps see mathematics as a social tool for critical consciousness (Frankenstein, 1989, Gutstein, 2005). While the current literature in social justice mathematics addresses some of the curricular dilemmas of being a social justice educator, the scholar's perceptions of TMSJ lets us with questions as to how to "play the game/ change the game" on a daily basis. Teacher educators and researchers need to consider our current definitions and understand how our current understanding of teaching mathematics for social justice has plateaued. Researchers need to look elsewhere to fields like Critical Ethnic and Gender studies to see how to examine how our current understanding of TMSJ may be reaffirming notions of anti-blackness (Martin, 2018), or not addressing modern-day civil rights of teachers and students. For example, in creating opportunities for students of color to participate in STEM fields, how might we also be asking students to simply participate in racial capitalism (Melamed, 2015), where they only count for diversity measures but not to re-imagine the field of mathematics, to show that it is not just that people need mathematics, but mathematics needs people (Gutiérrez, 2012).

Conclusion

The field of critical mathematics educators has reached the point of asking ourselves how can we better understand and theorize what it means to teach mathematics for social justice? How do we expand our current understanding of social justice beyond instrumental access and critical consciousness (Larnell, Bullock, Jett, 2016) of sociopolitical issues and a better understanding of teachers' roles in challenging systems of oppression? If we are to recognize teaching mathematics as a sliding signifier or a walking road (Cochran-Smith, 2004), how can we expand our current understanding of teaching mathematics for social justice as teachers embody their political *conocimiento* (Gutiérrez, 2012)? If we were to ask scholars in Critical Ethnic and Gender studies, would they agree with our current understanding and implementation of Teaching mathematics for social justice?

If the goal of teaching mathematics is to change and dismantle what we see within the relationships that we have within society teacher educators, need to provide more representations of how community members are addressing all these topics so that they can develop Political *Conocimiento* (that will inform their critical stance on mathematics education. Furthermore, we need examples of studies that look at how preservice teachers who are exposed to political knowledge how they implement it in their first year and beyond. If we believe that the development of critical mathematics, include aspirations and hopes that are continuously recontextualized and reformulated and, uncertainties appear (Skovsmose, 2009), we cannot expect that teachers will be successful at teaching mathematics for social justice unless we place value on more than just curriculum.

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