

Teaching Mathematics for Social Justice: Reflections on a Community of Practice for Urban High School Mathematics Teachers

Lidia Gonzalez

York College of the City University of New York

In this article, the author reports on a study that explored, in part, the developing identities of seven New York City public high school mathematics teachers as teachers of mathematics and agents of change. Meeting regularly as a community of practice, the teachers and author/researcher discussed issues of teaching mathematics for social justice; explored activities and lessons around social justice; and created a unit of study that attempted to meet high school level mathematics standards, while addressing a social justice issue affecting the lives of urban students. The author reports on the mathematics teachers' growing awareness of and concerns about infusing issues of social justice into their teaching as well as the teachers' evolving conceptions of what it might mean to teach mathematics in an urban school, of the nature of mathematics itself, and of what their roles as educators might include.

KEYWORDS: mathematics education, teacher development, teacher identity, teaching mathematics for social justice

Approaching mathematics through a social justice context has been proposed and used by some, including mathematics educators, as a way to address issues that confront urban youth from historically marginalized communities, while engaging them in the study of meaningful mathematics (see, e.g., Frankenstein, 1983; Gutstein, 2006, 2008). Although the idea of education as a vehicle for social justice has been around for decades (see, e.g., Freire, 1970/1993), it is only fairly recently that the idea has been applied to mathematics education:

Until recently, embedding mathematics pedagogy within social and political contexts was not a serious consideration in mathematics education. The act of counting was viewed as a neutral exercise, unconnected to politics or society. Yet when do we ever count just for the sake of counting? Only in school do we count without a social purpose of some kind. Outside of school, mathematics is used to advance or block a particular agenda. (Tate, 2005, p. 37)

LIDIA GONZALEZ is an assistant professor of mathematics at York College of the City University of New York (CUNY), 94-20 Guy R. Brewer Blvd, Jamaica, NY, NYC 11451; e-mail: lgonzalez@york.cuny.edu. Her primary research interest is in the teaching of mathematics for social justice. Additionally, she is working on a study of alternatively certified mathematics teachers in NYC and interested, more broadly, in efforts at improving the educational experiences of urban youth.

Within recent years, there does appear to be a growing interest with respect to teaching mathematics for social justice, as evident by the recent published edited volumes that focus on mathematics and social justice (see Burton, 2003; Gutstein & Peterson, 2005). How mathematics teachers might be prepared to teach mathematics for social justice, however, is an area still in need of exploration. Gau (2005) argued:

Despite the potential teaching math for social justice has in addressing issues of equity in mathematics education, little research exists that examines mathematics teachers learning to teach for social justice, a necessary step in beginning to understand the entailments of teaching mathematics for social justice. (p. 3)

It also has been argued that most of the existing examples of social justice units appear to rely on elementary mathematics rather than upper-level mathematics (Brantlinger, 2007; Brantlinger, Gutstein, Buenrostro, & Turner, 2007), though this reliance is somewhat changing as more lessons and materials become available (see, e.g., Gutstein & Peterson, 2005; Mukhopadhyay, Powell, & Frankenstein, 2009).

Thus, with these arguments in mind, I undertook a study with the explicit goals of illustrating how mathematics teachers might learn to teach mathematics for social justice and how teaching mathematics for social justice might be done within the context of the high school mathematics curriculum (see Gonzalez, 2008). In my study, I reported on the formation of a community of practice consisting of seven New York City (NYC) public high school mathematics teachers and me, the researcher and a former NYC public high school teacher. As a community of practice, the teachers and I shared and developed ideas on the intersection between mathematics, mathematics education, and issues of social justice. Together, we explored and generated knowledge around the idea of mathematics teachers as agents of social change and on the use of mathematics as a critical tool for understanding and working to improve social life, primarily those aspects most affecting the students served by the school at which the teachers of the study had taught. Additionally, we developed a high school level curriculum unit around a social justice issue that the teachers saw as relevant in the lives of their urban students, while also attempting to successfully attend to the standards-based content of high school mathematics without compromising the nature of the mathematics learned.

In this article, I report only a portion of my study, with an emphasis on teachers' developing identities as mathematics teachers and agents of change. In so doing, I focus on the teachers' beliefs about the teaching and learning of mathematics and their own roles as teachers of mathematics. Because identity and awareness mediate both action and pedagogy (Holland, Lachiotte, Skinner, & Cain, 2003), the article focuses on the teachers developing identities, exploring

shifts in their thinking and beliefs. In reporting partial findings, I draw heavily from the interviews and written reflections of the teachers who participated in the community of practice. Through using the teachers' own words, it is my hope that their beliefs about their roles as both mathematics teachers and agents of change might become transparent.

Conceptual Framework

Many education scholars, among them critical pedagogues, argue that mathematics (particularly Algebra) stands as a gatekeeper to future success (Apple, 1992; Burton, 2003; Gutstein, 2006; Martin, 2000, 2003; Moses & Cobb, 2001). This gatekeeping status is especially evident for low-income students of color that, for the purposes of this article, will be referred to as students from marginalized communities. The inequities that exist between students of marginalized communities (such as those taught by the teachers in my study) and their "mainstream" peers in terms of mathematics achievement, course-taking patterns, and enrollment in mathematics-related majors, are well documented (Burton, 2003; Gutstein, 2006; Tate, 1995, 2005). Addressing these inequities through the teaching of mathematics for social justice is viable and worthwhile to me, both as a mathematics education researcher and teacher of mathematics, especially given the extensive research highlighting the role that mathematics plays as a gatekeeper to future success (Burton, 2003; Moses & Cobb, 2001; Tate, 1995, 2005).

Defining *Teaching Mathematics for Social Justice*

The phrase *teaching mathematics for social justice* is not uniformly defined within the research literature. There are numerous definitions ranging from equal access to upper-level mathematics courses to social reconfiguration spurred by the use of mathematics as an analytical tool to understand social life and the inequities that exist therein. The definition of mathematics for social justice that I rely on, and that guided my work with the teachers, draws from the work of several researchers and is comprised of four components. The first of these components is access to high quality mathematics instruction for all students. Moses and Cobb (2001) argued that mathematics is needed to be a full participant in society, and likened the struggle for access to high quality mathematics instruction for marginalized students to the civil rights movement and access to voting rights for African Americans. Another way to talk about this component is to say that all students deserve a strong grounding in what is usually referred to in the literature as dominant mathematics. Gutiérrez (2007) defined dominant mathematics as that which "reflects the status quo in society, that gets valued in high-stakes testing and credentialing, that privileges a static formalism in mathematics, and that is

involved in making sense of a world that favors the views of a relatively elite group” (p. 39).

A second component of the definition that I rely on is a re-centering of the curriculum around the experiences of students from marginalized communities. That is, teaching mathematics for social justice involves building upon the experiences of students from marginalized communities, while exploring issues of social justice through mathematics (Gutstein, 2006). This component is supported by research that advocates for instruction to be centered on students’ experiences in order for it to be meaningful to them (Darling-Hammond, French, & Garcia-Lopez, 2002; Villegas & Lucas, 2002).

The third component is the use of mathematics as a critical tool for understanding social life; one’s position in society; and issues of power, agency, and oppression. This component is often referred to as critical mathematics and often set in contrast to dominant mathematics. For instance, Gutiérrez (2007) defined critical mathematics as “mathematics that squarely acknowledges the positioning of students as members of a society rife with issues of power and domination...[and] takes students’ cultural identities and builds mathematics around them in ways that address social and political issues, especially highlighting the perspectives of marginalized groups” (p. 40). In this way, mathematics becomes a tool used to examine social environments, increase awareness of social injustice, and serves as a valued language that can be used to further an agenda of social change towards a more just society. While increasing awareness is important, without a component that addresses change, the injustices that exist in society will continue to persist. In order to bring about social change, action and agency need to shape the perspectives with which we view mathematics for social justice.

Thus, the fourth component of teaching mathematics for social justice is the use of mathematics to radically reconfigure society so that it might be more just. Mathematics for social justice units and lessons, according to Gutstein (2006), should serve the purpose of “liberation from oppression” (p. 22); he argued that schooling should be a vehicle for empowerment and social change. This component is consistent with the position of many educational scholars who argue that citizenship should not involve blindly following the rules of an inherently unjust society, but instead should involve being a critical observer taught to understand the world and work toward making it more just (Aronowitz, 2004; Burton, 2003; Michelli & Keiser, 2005). Gutstein (2006) furthered this position specific to mathematics education, arguing “a crucial aspect of mathematics for social justice is what students do with the mathematics” (p. 14).

When mathematics for social justice is understood as a tool to further social change and the emancipation of oppressed communities, it is being viewed as an extension of Paulo Freire’s scholarship (see, e.g., 1970/1993) and his pedagogy of liberation. Frankenstein (1983) claimed, “Freire’s theory compels mathematics

teachers to probe the nonpositivist meaning of mathematical knowledge, the importance of quantitative reasoning in the development of critical consciousness...and the connections between our specific curriculum and the development of critical consciousness” (p. 318). Understanding mathematics as a means to develop a critical consciousness makes clear that the end product is not confined to equal academic performance or to equal access, but to a complete rethinking and restructuring of the current society.

Defining *Socially Just Society*

Given that the creation of a more socially just society is seen as a goal of teaching mathematics for social justice, it seems necessary to discuss and attempt to define what is meant by *social justice* and what a *socially just society* might look like. The work of Zollers, Albert, and Cochran-Smith (2000) looked specifically at the concept of social justice and its definition for a group of teacher educators. Their study aimed to “investigate individual understandings of the meaning of social justice and find the commonality necessary to ‘teach for social justice’” (p. 1). The teacher educators in their study linked social justice to issues of fairness and equity, personal and institutional responsibility, and individual and collective action. Michelli and Keiser (2005) described a socially just society as one in which each individual can realize their potential and access all life’s chances. Furthermore, it is a society characterized by nonrepression and nondiscrimination in which no one individual or group oppresses another. A related way of understanding social justice is the principle of distributive justice; characterized by an equitable distribution of society’s resources, including all that is both good and bad (Rorty, 1979). This idea is to distribute both the benefits and burdens of society among its members, though issues arise when one attempts to define how such benefits and burdens can and/or should be distributed and is often accompanied by a discussion of wealth and access to opportunities.

The scholarship noted above leads to a definition of social justice that includes access to opportunities and resources distributed in such a way as to not repress or discriminate against any one individual or group, whether for the good of another or not. A socially just society can therefore be characterized by equal opportunities, equal access, and the ability of all to reach their potential through access to all of life’s opportunities (Michelli & Keiser, 2005).

In addition to the scholarships noted, I rely on Gutiérrez’s (2007) benchmark for achieving equity in education. She argued that equity in education is “being unable to predict student patterns (e.g., achievement, participation, ability to critically analyze data/society) based solely upon characteristics such as race, class, ethnicity, gender, beliefs, and proficiency in the dominant language” (p. 41). We can expand upon this idea from Gutiérrez in order to define a socially just

society. In so doing, I argue that a socially just society is one in which we are unable to predict success in life based upon characteristics including—but not limited to—race, ethnicity, gender, beliefs, citizenship status, and proficiency in the dominant language.

Proponents of teaching mathematics for social justice argue that a more socially just society is possible through the teaching of mathematics for social justice (see, e.g., Gau, 2005; Gutstein, 2006; Gutstein & Peterson, 2005). In order for teachers to teach mathematics for social justice, however, they must be prepared to do so.

Preparing Teachers as Agents of Change

Professional development programs for inservice teachers as well as teacher education programs for preservice teachers are now beginning to address issues of social justice (Darling-Hammond, French, & García-Lopez, 2002). Sleeter (1997), in discussing a professional development opportunity for teachers to learn to teach in multicultural ways (a possible precursor to teaching for social justice), explained that the most common result of the training was that teachers became “more aware of the differences among their students, student learning styles, racism in society, cooperative learning, curriculum, and school problems” (p. 688). Gau (2005) also noted that the biggest change in the preservice mathematics teachers she worked with in her mathematics for social justice project was an increased awareness of differences. It is this awareness that teacher preparation programs should, I believe, strive for. By becoming aware of their students’ backgrounds and of their own position in social life, both Sleeter and Gau argued that teachers often become ready to act on this knowledge for the betterment of students. Teaching for social justice involves teachers and students becoming increasingly aware of their social realities and of one another’s respective histories, cultures, and understandings. The development of teachers’ identities as agents of change and discussion about the role of teachers as political agents is also necessary (Villegas & Lucas, 2002).

As our behavior is mediated by our identities, changes in our behavior require changes in how we see ourselves (Holland et al., 2003). Identities affect agency and action, making identity development an essential element of teacher preparation. In defining identity, Holland et al. stated:

People tell others who they are, but even more important, they tell themselves and they try to act as though they are who they say they are. These self-understandings, especially those with strong emotional resonance for the teller, are what we refer to as identities. (p. 3)

Our identities therefore are “something that arises from a transaction rather than being an inherent feature of a material body” (Roth, 2005, p. 326). Consequentially, teachers’ identities, as those of all of us, are developed through social interactions. It is through interaction with others that we grow and develop in terms of how we see ourselves, forming and shifting our identities as we are pushed to entertain new ways of being (Holland et al., 2003). Entertaining these new ways of being often drives us to act in previously unexplored ways as we redefine who we are. Considering new ways of being is the first step in changing one’s pedagogy (Florio-Ruane, 2001). Therefore, in order to affect changes in teachers’ practice, preparing them to teach mathematics for social justice, we must, I believe, begin by affecting change in their identities. Teachers need to come to see themselves as agents of social change if they are to implement mathematics for social justice in their teaching (Gutstein, 2006).

Using Communities of Practice

The idea that learning is a social process has led many teacher educators to use *communities of practice* as vehicles through which to prepare teachers (see, e.g., Choi, 2006; Florio-Ruane, 2001). A community of practice, as defined by Choi (2006), is a “community that shares and creates real knowledge” (p. 143). It refers to groups of people; in this case, the participants and me, who are “bound by their shared competence and mutual interest in a given practice” (p. 143)—the teaching of mathematics for social justice. According to Wenger (1998), communities of practice contain the following three dimensions: mutual engagement, a joint enterprise, and a shared repertoire.

When talking about mutual responsibility, however, it is important to note that Wenger (1998) neither specified that the responsibility for the group be shared equally among its members, nor did he infer that equal sharing was possible. Members have different knowledge, experiences, and positions within the group that they bring to the experience, allowing for collective work—with different contributions—on a joint enterprise.

Wenger (1998) also described communities of practice as communities in which there is prolonged engagement by the members as they work toward a joint enterprise. Through using communities of practice as vehicles for professional development in the teaching of mathematics for social justice, the teachers work over prolonged periods of time (not the more common workshop model) to arrive at understandings about what it might mean to teach mathematics for social justice as well as how to prepare to do so.

Although it is not a necessary condition of a community of practice, the idea that power in the group should be shared, is supported by advocates of teaching mathematics for social justice, who argue that students and teachers together should be jointly responsible for what occurs within the classroom, including

what is taught (Gutstein, 2006; Gutstein & Peterson, 2005). While Wenger (1998) argued that there are power dynamics at play in any community, the idea of sharing power with the teachers in a community of practice aimed at professional development is aligned with the goals of critical theorists who attempt to disrupt the power dynamics that presently exist in society, including those in situations such as the professional development of teachers (McLaren, 2000).

Given the social conception of learning and the characteristics of communities of practice as outlined, these characteristics become powerful ways through which teachers can develop as educators. Communities of practice are touted by Choi (2006) as “the most suitable learning method not only for achievements of tacit knowledge based on participation and practice in real world contexts, but also for implicit knowledge, which is passed easily through represented and systematic forms by practice at a group level, not at a personal level” (p. 143).

Methods

Although the larger study aimed to answer four broad questions, this article focuses specifically on those questions pertaining to teachers’ views and beliefs about the role of teachers and the nature of mathematics and mathematics teaching and learning. Or, more broadly, the teachers’ developing identities. As a result, the focus of the analysis presented here will be teachers’ changing views of whom they are and what their practice does and should entail. To this end, I focus on two of the study’s research questions: (1) How do these teachers view and understand the teaching of mathematics for social justice? (2) How, if at all, does exposure to ideas about social justice and mathematics affect teachers’ beliefs about teaching mathematics, the nature of mathematics, and their roles as teachers and agents of change?

Recruitment of Participants

While working in an unrelated study, I assisted in the collection of data at several schools, one of which I will refer to as Urban High School. This school is a large, comprehensive public high school in NYC that relies on a reform curriculum very unlike the “traditional” mandated NYC curriculum. It was suggested to me that as a result of teachers’ familiarity with a reform-based curriculum, the school might be a good fit for my study. This suggestion was based on the assumption that the teachers at Urban High would be more open to trying activities around the teaching of mathematics for social justice as compared with teachers at other schools whose curriculum was more traditional and whose ideas about what constitutes mathematics and the teaching of mathematics might be more narrowly defined.

I first approached the assistant principal of mathematics at Urban High and later the principal to obtain support for the study to be conducted with Urban High's mathematics teachers. After the appropriate permissions were obtained, the assistant principal of mathematics provided me with a list of email addresses for the teachers in the mathematics department. I forwarded a description of the research project to the teachers along with information about what participation in the study would include. Participation included: attending group sessions, participating in three interviews, and writing reflections after each group session. Potential participants were also told that in exchange for their participation, they would receive a copy of the edited volume *Rethinking Mathematics: Teaching Social Justice by the Numbers* (Gutstein & Peterson, 2005), copies of all of the articles and materials used during the study, and would be paid a monetary sum comparable to that which they would receive for participating in similar professional development opportunities through the NYC Department of Education.

Eight of the nearly 30 mathematics teachers at the school expressed interest in the study. Of these, only one was declined due to scheduling issues, which is perhaps unfortunate as he would have been the only male participant. The participants, therefore, were seven female mathematics teachers who all worked in the same NYC public high school, Urban High, during the 2006–2007 academic year, though by the time that the data were collected (during the 2007–2008 academic year) two of the teachers had moved to other schools; they elected to be a part of the study nonetheless.

The School

This section serves to describe the school and relies on statistics obtained from the NYC Department of Education's Web site. In order to keep the name of the school confidential, the school's Web site from which the data was obtained does not appear in the list of references, although the homepage of the NYC Department of Education does. Urban High is a large, comprehensive, public high school in NYC, serving over 3,000 students in grades nine through twelve. The physical building is very large with wide, ample hallways. One particular floor contains multiple classrooms, many of which are devoted to mathematics. The rooms are wide, with dry-erase boards and trapezoidal tables arranged in groups of two forming hexagons. The school administration places emphasis on the use of group work; the tables facilitate this pedagogical approach.

The vast majority of students at Urban High (as of December 2007) were classified by the NYC Department of Education as Black (55%) or Hispanic (41%). Furthermore, a commonly used—though often misleading—measure of a school's overall socioeconomic status (SES) is the percentage of students who qualify for free or reduced-priced lunch. At Urban High, for example, in the

2005–2006 academic year 38% of the students qualified for free or reduced-priced lunch. The percentage presented is the ratio of the “number of approved lunch applicants” to the number of full-time students at the school (New York State School Report Card Accountability and Overview Report, 2006). The participants in my study, however, explained that due to the large number of students at the school, that some of the cafeterias (there were more than one) were converted into classrooms and so as to not overcrowd the remaining cafeteria, students were encouraged to take their lunch period (a required part of students’ education programs in NYC) at the end of the day. Students who had lunch during the last period of the day usually elected to leave the school and eat lunch elsewhere. As such, the number of applicants for free or reduced-priced lunch was quite low because of the high number of students who do not eat lunch at the school.

Several members of the school’s administration, when asked directly about this school policy, indicated that students may elect to take their lunch period last and that the overwhelming majority of those who do, leave the building at that time, as such they do not submit lunch applications. I asked several members of the administration, as well as all of the participants in my study, and several other teachers that I met on one of my visits, to estimate the percentage of students who might qualify for free or reduced-priced lunch (including those who might not apply), the various estimates I received hovered around 75%. This much higher percentage was representative of similar public schools in the city, as defined by the NYC Department of Education using data on its Web site. That Urban High is a large, comprehensive school in an urban area serving students who are primarily from historically marginalized communities made the school an attractive one for me to conduct my research study.

Furthermore, after a long struggle, Urban High was able to select its own mathematics curriculum. The struggle to use a “non-traditional” mathematics curriculum was challenging, as explained by the school’s assistant principal of mathematics, but something that she felt was necessary. The teachers often made reference to the fact that the assistant principal of mathematics put her job “on the line” to be able to use a non-traditional mathematics program.

This non-traditional mathematics program is characterized by the use of exploration and discovery activities that highlight mathematics concepts which students discover as they work through the activities. The program places heavy emphasis on problem solving; problems are contextualized in units that revolve around certain themes. As with most teachers, the participants seemed to believe that the curriculum was strong in some areas, especially in getting students to break down problems, but that it was lacking in others. The teachers believed that the curriculum did not expose students to the types of questions they are likely to see on the standardized examinations and that it used imprecise language. While the curriculum encouraged students to engage in and struggle with non-traditional

problems while learning to deconstruct the material, the teachers believed that students could not always relate to the contexts provided, and that supplementation was needed. In general, because the teachers worked with a non-traditional and contextualized mathematics curriculum, Urban High was appealing to me. I imagined that the teachers might be more open to using mathematics for social justice lessons and activities, compared to those who worked at a school using a more traditional mathematics program.

The Participants

The participants were seven female mathematics teachers who worked at Urban High during the 2006–2007 academic year. Each teacher had between 1 and 4 years of experience at the beginning of the study, and at least 1 year of experience using the school's non-traditional curriculum for mathematics. The familiarity with the school setting and curriculum assisted the teachers in ascertaining the supports and limitations of implementing different activities in the mathematics classroom.

As a result of the self-selective nature of the group, the teachers were, in some ways, not representative of those in the school's mathematics department or the school in general, based on data obtained from the school's assistant principal of mathematics and from the participants themselves. In that, all of the participants were women, despite roughly one third of the mathematics department being comprised of men. Additionally, as compared to others in their department and the school, the participants were more likely to be from racial and ethnic backgrounds similar to Urban High's students. Six of the seven teachers, approximately 86%, identified as Black or Hispanic, while in both the mathematics department and the school as a whole less than 33% of the teachers did so. According to data obtained by the National Center for Educational Statistics (n.d.) 25.5% of public school teachers in urban areas such as NYC identify themselves as Black or Hispanic, significantly less than when considering the participants, approximately 86% of who identified themselves as Black or Hispanic (i.e., all but one, Vanessa).

Moreover, this group of seven teachers tended to be less experienced than those in the school as a whole. While approximately 55% of the teachers at Urban High had taught in the NYC public school system for over 3 years, only 43% of the teachers in my study had done so. Additionally, while 25% of the teachers at Urban High had been in the NYC public school system for over 5 years, no one in my study had been. The participants ranged from having 1.5 to 4.5 years of teaching experience, with the mean being 3.2 years. Research highlights that teachers in urban settings tend to differ from their students with respect to characteristics such as race and ethnicity, family background, and socioeconomic status, making

it difficult for them to relate to their students (Darling-Hammond, French, & García-Lopez, 2002). Yet, the teachers in this study were predominantly from the same racial backgrounds as their students. And all but two reported growing up in families of low-socioeconomic status, with four reporting that their family had been on public assistance when they were growing up. (Table 1 provides background information about each teacher.)

The Mathematics for Social Justice Group

The Mathematics for Social Justice Group was a professional development opportunity for the teachers designed as a community of practice. It was not a college course, nor a course for which the teachers received credit or a certificate of any kind. It was not affiliated with any school or professional program. As the researcher, I was both a participant in the group and its facilitator. I did not “grade” the teachers, nor report their “progress” to anyone at the school or elsewhere. The group was a professional development opportunity for the teachers and formed part of my dissertation research (Gonzalez, 2008).

The group that the teachers participated in met weekly for a total of 10, 2-hour sessions. Meetings were held at Urban High during the academic year. Specifically, we met in Vanessa’s classroom on Friday afternoons after classes had ended for the day and enough time had passed for those no longer at the school to arrive. Our first meeting began with a discussion of what social justice is and how we might recognize a socially just society if we saw it. The idea was to allow an intellectual space for us to explore our own conceptions of social justice and, in later sessions, explore how our work as teachers of mathematics might serve as a vehicle for social change.

Our first five sessions involved reading texts related to the teaching of mathematics for social justice. Articles, chapters from books, and other relevant materials from such authors as Gutstein (2006), Gutstein & Peterson (2005), Martin (2003), and Tate (2005) were read and discussed with the aim of understanding how teaching mathematics for social justice is defined in the literature and how it might play out in the classroom. Critical discussions about these readings and previous work that has been done formed the basis of our first few meetings. In addition, the participants and I engaged in activities and lessons that are currently available in the mathematics for social justice literature, allowing us an opportunity to explore some of the resources that exist and to discuss their perceived strengths and limitations. In the final sessions, the group developed a unit that linked high school mathematics (for first-year high school mathematics) with issues of social justice.

Table 1
Summary of Participants

Name (pseudonyms)	Age	Race/Ethnicity	Exp. (years)	Years at Urban High	College major	Teaching license	Articulated connections to school and students
Ellen	Mid 30s	Mixed (African American/White)	3.5	3; left to work at the suburban HS she had attended	Finance	Middle school math	None, beyond her race and working at Urban High
Jenna	Low 30s	Hispanic	3.5	3.5	Information Systems	Middle school math	Lives in neighborhood; similar in experiences and background (i.e., SES)
Melissa	Mid 30s	African American	3.5	3; left to work at small charter school	Economics/Accounting	High school math	None, beyond her race and working at Urban High
Monica	29	African American	3.5	3.5	Engineering	High school math	Attended Urban High; lives in neighborhood; similar in experiences (i.e., SES)
Nyo	Upper 30s	African (Nigerian)	4.5	4.5	Engineering	High school math	Attended Urban High
Reina	Low 30s	Hispanic	2.5	.5; taught 2 years at a middle school	Engineering	Middle school math	Lives in neighborhood; similar in experiences and background (i.e., SES)
Vanessa	Mid 20s	White	1.5	1.5	Chemistry/Mathematics	High school math	Similar in experiences and background (i.e., SES)

It was my intention at the start of my study that the teachers take more responsibility with respect to how the group should run and what we would do as time went on. On several occasions, I told the teachers that if they had anything

interesting for us to read and discuss that we could substitute their suggested readings for the readings I had originally planned; however, none of the teachers ever approached me with readings they wished to use. On other occasions, I set out some options in terms of how to proceed with the session at its start. Despite these attempts to make the sessions more participant centered, for the first six sessions the teachers deferred to me in terms of how the session should proceed and none brought in a text to read or an activity that they wanted to share with the group. The shift in power and responsibility about how the group would run, and that I had longed for, did eventually become reality, however.

In sessions 6 through 9, the teachers were the ones who determined what topic our unit would address, how to proceed with the development of the lessons, and who would be responsible for what. The last session again featured the teachers determining how we would proceed. In this session, each was an expert on work they put forth as they created it. If someone had walked in on this last session (any time after the first few minutes), it would have been virtually impossible to tell who the participants were and who the researcher was because each of us was taking turns as the presenter, as the leader of the group for the few minutes that we each took to speak about our part. Everyone had something to offer and, at the same time, something to learn.

Our Mathematics for Social Justice Unit

In their initial interviews (discussed later in the article), each of the teachers expressed a passion for education and many commented that the educational opportunities afforded to the students at Urban High often leave them ill prepared for the future. This perspective, coupled with the desire that our unit be relevant to students and something they could all be “on the same side of,” led the teachers to create a unit aimed at answering the question: *How well does Urban High School prepare its students for the future?* The teachers saw this question as an issue of importance to their students and one that the students might have interest in.

The teachers also felt that improving their school was an attainable goal their students might work toward. Whereas, tackling a bigger social issue, such as how the unemployment rate or poverty levels are calculated, might lead to both good discussions and applications of mathematics, it might not result in any change or resolution. Reina noted, “I loved the unit we decided upon because it is something practical, that [students] would need immediately and could DO something about” (session 9 reflection). It was important for the teachers that the students be able to instill change in meaningful ways. They wanted the students to feel aware and motivated, to be able to describe the situation using mathematics, and to take action at improving the situation they were to explore. Additionally, keeping in mind the fact that they might not be able to use the unit as a whole giv-

en the scope, sequence, and pacing guide that drove their curriculum, the teachers hoped to create a collection of lessons that together could form a cohesive unit, but that could be used independent of one another so as to facilitate implementation.

The overarching question of the unit was explored using two approaches. The first of these focused on how Urban High was preparing their students as compared to other public high schools in NYC. Vanessa, Reina, and I worked on this part of the unit. Relying on statistical datasets available on the NYC Department of Education Web site, we developed lessons and problem sets that compared statistical data on Urban High to two similar, large, open-admission schools and one specialized high school. The statistical data used for comparison included: graduation rates, standardized test scores, incidences of violence, number of Advanced Placement classes, and so forth. The focus of this part of the unit was the use of mathematics to understand the way in which Urban High prepares its students as compared to other NYC public high schools and, from this analysis, to determine what changes might be needed to improve the school's ability to prepare its students for the future. Exploring what might be extrapolated from these datasets involved mathematical analyses of why some of the statistics might be misleading, what can and cannot be answered by the statistics, and the implications of the statistics on student learning and preparation. This part of the unit was in line with the work of Freire, as described by Frankenstein (1983), who wrote, "Freire's concept of critical knowledge further directs us to explore not merely how statistics are non-neutral, but why, and in whose interest" (p. 324).

The second approach used to determine how Urban High prepared students was accomplished by comparing the opportunities students have at the school with the entrance requirements at various types of colleges and for various majors. By looking at how an Urban High graduate might fare when applying to various colleges and analyzing how prepared they would be to pursue various courses of study (e.g., mathematics/science-related majors, liberal arts-related majors, performance majors), this part of the unit aimed to address the overarching question of the unit. "My hopes are to get students thinking about the best fit for a college in terms of what they wish to study and how their grades help them fit into an appropriate area of study" (Nyo, session 7 reflection). Nyo and Monica worked on this part of the unit, which also included lessons on understanding one's transcript and on the graduation standards. The teachers believed that despite having to meet these standards in order to graduate, many students were often unaware of them.

Following these two parts of the unit, the students would then prepare presentations to share their results with members of the school community, such as administrators, parents, teachers, and others. In so doing, they would not only demonstrate where the school was in terms of preparing students, but also they

would advocate for changes that they saw as necessary for Urban High's graduates to be prepared adequately for the futures they wish to pursue.

The third part of the unit dealt with financial preparation. Melissa and Jenna undertook development of a sub-unit on financial mathematics with the belief that the school was not teaching students the skills required to be successful financially in the future. Aimed at addressing this deficiency, this part of the unit included lessons on how to balance a checkbook and how interest is calculated on credit cards and other types of loans. As an element of this part of the unit, students would create a budget based on data obtained through the Department of Education Web site about what the typical Urban High student was planning to do after graduation.

Finally, Ellen, who worked alone, explored ways in which the information students learned from the unit might be shared with others. She wanted to develop a forum for change where students could share their knowledge with incoming students so that new students could take full advantage of the opportunities available at the school. She also envisioned creating opportunities to inform parents and others about the school, the opportunities it provides, and also what students and parents need to do in conjunction with teachers and the school administration to ensure student success. Her idea took the form of a "Success Day" event that would have older students welcoming new students and their parents to the school in order to foster a culture of success at the school. She created an outline for the day's events that she proposed to the administration of her new school for use at the start of the 2009 school year.

The teachers' engagement in the unit transcended our Friday meetings. That is, their work on the unit was not confined to the 2 hours we met on Fridays, but rather something that they did all throughout the week. For example, in her session 6 reflection, Jenna noted, with respect to her group, "We plan to spend this week doing a bit of research and bringing it into the next session." Similarly, others spent the time between sessions looking up information and reworking their parts of the unit. The teachers' work on the unit and the fact that they were spending much out-of-session time on it led us to postpone the last session. Instead of meeting 1 week after session 9, we let 2 weeks go by before meeting in order that we would have more out-of-session time to work on the unit.

The teachers responded positively to the unit they created and saw it as both relevant to and useful for students. Vanessa explained, "Yeah, oh yeah, I think the kids would really be interested in it...this is stuff that's directly related to their life" (exit interview). Others noted that students often complain about what they learn in mathematics, seeing no use for it in their daily lives. Jenna wrote in her session 7 reflection: "Students have the habit of complaining that they aren't going to use most of what they learn in high school." She added, however, that with respect to our unit, "They're definitely going to need all of this."

Interestingly, the teachers criticized the level of mathematics in some of the social justice activities we explored as part of the group sessions, but they did not raise this same concern with respect to the level of mathematics in our unit; even though some parts of it were informational, but devoid of any “rigorous” mathematics. When asked about the lack of mathematical rigor in the finance and budgeting sections of the unit, Melissa and Jenna, the creators, both agreed that the mathematics in this part did lack rigor. On the other hand, they pointed to the fact that understanding the content of the lessons in this part is necessary for students as they move beyond high school and that, as it is not covered elsewhere in the curriculum, it is important that students be exposed to it.

The most rigorous mathematics part of the unit was aligned with grade nine mathematics standards in NYC, addressing topics such as ratios, percents, and the use of graphs and tables to display data and probability. These are the same topics that are most often covered in the mathematics for social justice lessons which currently exist and those that the participants and I explored as members of the group.

I think that the first part of the unit, the statistical comparison of the schools, was much more aligned with the ideals of teaching mathematics for social justice than the other parts. It used data that were readily obtainable to explore and compare various schools, thus exposing the differences in quality and scope of preparation offered to students. It highlighted the deficiencies that exist in some NYC public schools, specifically those that serve students in marginalized communities as compared to more “successful” schools serving mainstream students. It prepared students to understand these inequities statistically with the hope that by so doing students will be motivated to advocate for changes within their school to assist in mitigate them. This advocacy was further supported by the framework of Success Day as well as by providing avenues for students to share their concerns and ideas for improving the school with other stakeholders such as school administrators, community leaders, and parent groups.

Data Collection

Each teacher participated in two semi-structured interviews that I conducted with the goal of ascertaining the participants’ initial and developing beliefs about their identities as mathematics teachers and agents of change. The initial interview was held prior to the start of the group sessions; it included in-depth questions that addressed the participants’ views about their own activism, the teaching and learning of mathematics, and their identity as mathematics teachers and agents of change. Also explored in the initial interview were the participants’ beliefs about the role of teachers, their views of the students whom they taught, and their reasons for joining the study. To note developments in the teachers’ thinking, the exit

interview, also a semi-structured, in-depth interview, contained many questions similar in nature and content to those in the initial interview, allowing me to discern changes in the teachers' thinking about various issues. Other topics driving the questions in the exit interview were teachers' views of their developing identities, their opinions about the community of practice, and their thoughts about the teaching of mathematics for social justice. (There were additional, ongoing interviews conducted; they are discussed later in the article.)

Researcher interview. I was interviewed by members of my dissertation committee at the start of my study as well as at its end. The interviews followed the protocol used for the initial and exit interviews of the participants, allowing me to ascertain my initial identity and beliefs and how these (might) have changed throughout the course of the study. This procedure also served as a way of somewhat gauging my beliefs and perceptions against those of the participants.

Teacher reflections. The teachers were asked to write a reflection at the conclusion of each group session, addressing the activities or discussion of that session. At times, open-ended questions were provided to the participants to guide their reflections. In all cases, however, teachers were reminded that they need not be bound by these questions and were encouraged to also address other issues or concerns that they might have. As the researcher, I, too, answered these guiding questions, when provided, in my own reflections.

In addition to the teachers' reflections, I interviewed one teacher informally at the end of most group sessions in order to catch "fresh" reactions, suggestions, and thoughts (these are the ongoing interviews previously mentioned). The teacher interviewed rotated so that each had a chance to be interviewed in this manner. This interview, an oral reflection, was done with the hope that I could probe teachers' reflections a bit more than was possible when they reflected on their own in writing in order to gather rich data about the participants' developing beliefs and identities.

Video data. While each of the group sessions was videotaped in its entirety, a thorough analysis of the video data has not been undertaken at this time. The analysis for this article is drawn from the interviews and reflections (as previously noted). Nonetheless, an analysis of the video data, I believe, will provide further insights into the participants' developing identities, their beliefs and understandings of mathematics for social justice, and the use of communities of practice as vehicles for professional development. It is the focus of my future work.

Researcher journal. In attempting to understand my role in the group along with my identities as a researcher, mathematics teacher, and agent of change, I kept a researcher journal in which I reflected upon these topics after group sessions. These reflections involved formal reflections similar to those the participants completed at the end of each session, as well as informal writing about ideas and issues as they emerged. The journal served several purposes, one of which

was to see how my own thinking and identity developed through time. A second purpose of the journal was to monitor my own subjectivity, attempting to understand and document how my own history and beliefs affected both data collection and analysis. Finally, the journal served as the place where I reflected after group meetings, forming an initial, perhaps informal, way of understanding and analyzing the data.

Entries in the journal served the function of analytical, methodological, and personal memos (Strauss & Corbin, 1990). That is, in part they played an analytic role providing a place to make initial inferences about the data, raise questions, and note emerging themes. The entries also in part allowed me to consider how to approach the next session or phase of the research project; therefore, they served an important methodological role.

Data Analysis

Data analysis was an open-ended process involving constant, continual reflection. In keeping with the recommendation of qualitative researchers, data analysis took place throughout the data collection process and not entirely at the end of the study (Creswell 2005; Strauss & Corbin, 1990). This procedure enabled the refining of methods and future data collection. One example of this refinement was the addition of a written reflection by the teachers and me at the start of each session that was not part of the original data collection methods. These reflections were added later on in the study, both as a way of discerning participants' individual thoughts about warm-up activities and as a way of focusing the group at the start of each session.

Before my initial round of coding the data, I read through the text-based data several times in order to get an understanding of the whole of the transcribed discourse and, at that time, wrote some initial findings based on these readings that I then looked to for support when the data were later more systematically analyzed. Given the nature of this work, my belief in the validity of teaching mathematics for social justice, and the goal of preparing teachers to teach in this manner, I came to my study with a fairly well-articulated (preconceived) agenda, complete with research questions, analytic categories (e.g., teacher identity, teacher understandings of mathematics for social justice), and the goal of preparing teachers to teach mathematics for social justice. Although I was open to themes that might "emerge" from the data, the fact that I had research questions I wished to address made it impossible to go into the coding process without any preconceived ideas. My interest in the teachers' developing identities and in their understandings of teaching mathematics for social justice necessitated the development of codes that addressed these issues. Working definitions of the codes were constructed and refined as the coding scheme was applied to the data. These codes represented themes that were derived from my interaction with the data and

included the teachers' developing understandings of teaching mathematics for social justice, their awareness of the literature, and changes in their "style of talk" that I had not foreseen.

The analysis of data was done in two ways. One was to look at the coded statements across time for each participant, allowing me to "see" changes across time for each participant. A teacher's understandings of mathematics for social justice, for instance, could be traced using this method across time. A second method was to compare the coded statements across teachers by topic, noting agreement and disagreement between their beliefs and understandings.

Reliability of Findings

In an effort to present reliable findings, various procedures were undertaken. These included the use of multiple methods of data collection and multiple data sources, an essential component of trustworthy research (Creswell, 2005; Strauss & Corbin, 1990). Findings were triangulated by data source (participants and researcher) and data collection method (interviews and reflections). Incongruous or conflicting information that surfaced was noted with the belief that negative cases strengthen research by contextualizing findings. Ongoing interviews with the participants as well as their written reflections allowed me to learn about how they viewed their participation in the group, the nature of our meetings, and their understanding of various constructs, as well as their own developing identities. My own views and the patterns were checked against the views and patterns that the participants perceived and related back to me. Additionally, the participants were presented with various preliminary findings through phone conversations and email exchanges and provided feedback with respect to these (i.e., member checking).

Findings

My analysis of the data demonstrated that the teachers were acutely aware of the injustices that their students face; they were acutely aware of students' home lives, inadequate academic preparedness, and the lack of opportunity available to them and their families. As previously mentioned, five of the seven teachers are from similar backgrounds as their students and feel they share the experiences of these urban youth. Those with similar backgrounds saw themselves as being able to succeed in society despite the lack of opportunity because of their reliance upon education. They saw education as the way to future success, although they were cynical about the education their students receive. In her initial interview, Melissa, noted:

I believe that sometimes the curriculum is set up towards the government. Obviously, if they're picking the curriculum, they're picking what they want you to learn. They want to shape you in the way they want to shape you. The old school that I used to work with is just that—we just want to produce servants. We just want to produce someone who will be the serving class. It was not geared toward producing these high-level, educated, intelligent individuals.

The teachers, as Melissa's quote exemplifies, saw the public school at which they had taught, as well as similar schools, as producers of servants and not leaders. They feared that their students are being done a disservice and struggle with the fact that they are a part of the very system that is keeping these students from succeeding. Melissa was one of two participants (the other being Ellen) who have young sons of color and who vehemently opposed sending their sons to Urban High or similar schools, as they believe that these schools are not adequately serving students—most notably, young men of color. They both talked about toying with the idea of starting a school specifically for this population of students. Neither Melissa nor Ellen has their son enrolled in a NYC public school, nor do they have plans to do so. Melissa explained:

And I refuse—I told my husband, I will quit my job and be a home-school teacher instead of putting my child in this little zoo, any zoo that they got going here. I do not trust the system. I don't trust them, not with my black, male child. I know it sounds crazy, but I just don't because if you look at the, you know, what they have been producing, they haven't been producing much. (initial interview)

Her sentiments were echoed by Ellen, who has her son enrolled in a suburban school, and by some of the other teachers who have labeled these schools as “pipelines to prison,” especially for male students from marginalized communities. It is interesting to note that neither Ellen nor Melissa still work at the school, choosing instead to work in schools serving more mainstream students.

The teachers' initial ideas about social injustice was that it is prevalent—something both they and their students deal with constantly—and that it could be addressed through school better than *in* school, as mathematics for social justice proponents aim to do. Their love of mathematics and interest in social justice issues drove them to participate. It was their awareness of such issues and their eagerness to address them that led them to the group.

Although all but three of the teachers noted a lack of familiarity with the phrase *teaching mathematics for social justice* in the initial interviews, this lack of familiarity referred mainly to a lack of awareness of how the term is defined in the research literature. The teachers, as evidenced by their initial interviews and our first group discussions, did indeed have their own construction of what teaching mathematics for social justice might mean. This construct, to them, consisted of some aspects of the four components of the definition of mathematics for social

justice previously discussed, as well as a view of how they, as teachers, might be agents of change. For example, two of the teachers, Nyo and Vanessa, admitted that they had not heard of the expression teaching mathematics for social justice, but explained their understanding of the topic. Nyo's definition involved bringing real-life situations and contexts into the classroom. Instead of relying on problems devoid of context, teaching mathematics for social justice for her, initially meant, "incorporating social issues in sort of a word problem" (initial interview). Nyo's initial understanding of teaching mathematics for social justice addressed the need to bring social issues and real-life contexts into mathematics education consistent with the re-centering component of the definition previously presented as well as with the use of mathematics as a way of examining and understanding issues in society.

Initially, Vanessa described mathematics for social justice as, "maybe like integrating certain things that students would relate...for them to have a better understanding about mathematical context using context, but something that's more familiar" (initial interview). Vanessa also believed from the start that education should be a means for raising class consciousness and, though these are not her terms, teaching for liberation in the Freirian sense: "I wanna be able to raise some of these issues to my kids and be able to address them and discuss them and maybe to open up their eyes to what exists" (exit interview).

Melissa noted that she brings social issues into her teaching. Mostly, this effort involved bringing up individuals of color who were noted mathematicians and scientists and asking the students to find examples of such individuals as well:

I used to bring articles, and I used to—during Black History Month, I used to tell them that, "You have to find a mathematician that was either African-Caribbean, African-American, African-Latino that you know, and read about it, and you get extra credit if you come up, and you present, and you talk about it." And I would also, before the test, extra credit would be, "I'm gonna read you a passage of a person that created all these things, and they were black." And I would read about it, and the kids would take notes, and they can use their notes for extra credit. (initial interview)

While there is an element of critique or conscious raising that is consistent with teaching for social justice, Melissa's comments are what many researchers call the "heroes and holidays" approach to multiculturalism in education; this limiting approach was also common to the initial conceptions of teaching mathematics for social justice that some of Gau's (2005) preservice teachers had at the start of her study. The definitions initially put forth by Nyo, Vanessa, and Melissa include bringing the "real world" into their classrooms, but are vague as to how to do so; again, similar to what Gau found of her participants' initial views of teaching mathematics for social justice.

As they were introduced to activities and lessons created around the idea of teaching mathematics for social justice, the teachers began to see the political nature of mathematics teaching and realized how mathematics might be used to highlight social injustice. The teachers quickly realized the power of mathematics for social justice activities to raise student awareness of the injustices prevalent in society. Vanessa spoke of these lessons as a way of raising “class consciousness” (exit interview), which is parallel to Freire’s (1970/1993) “massified consciousness” (p. 17) and forms a key component of teaching for liberation (Nasir, Hand, & Taylor, 2008). Reina noted that mathematics for social justice lessons are “a way to get the kids to be aware of what’s happening around them” (exit interview). While the teachers disagreed as to how aware their students are of various social and political issues, they all commented that engaging students in mathematics for social justice lessons would result in increased awareness.

When asked in their exit interviews about their roles as agents of change, all of the teachers pointed to the changes that they affect in their students within their own classrooms as evidence that they are agents of change. This response was consistent with the experiences of Coti (2002) as he reflected upon a similar professional development opportunity he engaged in. Vanessa, on the other hand, stressed her desire to raise class consciousness as a means of affecting broader change in society, noting that she needed to further consider how to best do so within her classroom. Many of the teachers noted that they did not initially realize the power they had as teachers to affect change in the broader society and that this power was something they were now beginning to consider:

So this group kind of made me more like, “Well, I have this intelligence. I need to use it for good.” Yes. With much power comes much responsibility, so it just, it made me more aware that I need to be more socially active, that, you know, I need to be part of affecting change, because no one’s gonna do it for me kind of thing, and it also made me feel like I have more of a sense of like the same thing I was saying about the kids, like ownership, like I have control over what could happen, you know, but I’m choosing not to exert that control and that power. So these sessions kind of made me like, “No, I have to. I have to, because I have that responsibility as someone who knows.” (Reina, exit interview)

The power to affect change in society through their students was also a new idea that many of the teachers were beginning to understand. “I learned new ways students could change their environment while involving math,” wrote Monica in her session 9 reflection, adding that she was excited at the possibility of helping students to do just that.

The teachers realized that mathematics for social justice activities could lead to student empowerment and larger societal change: “It would give [students] a voice if you realized that there was actually something that they could do or say about an issue” (Ellen, exit interview), and “definitely would make [students]

more empowered” (Reina, exit interview). Empowerment, the teachers argued, could lead to change: “You could change the community,” Monica noted in her exit interview. Similarly, in her exit interview, Reina explained that through mathematics for social justice students would “feel like they can affect change.” At some point or another, each of the teachers suggested that students often feel disempowered because of their situation/life experiences, noting their students “see how hard the world can be” and “feel like there’s no hope” (Monica, exit interview). Having students realize their agency by working towards social change was seen as a way of combating this learned helplessness. The teachers saw this positive change in their students as a possible outcome of teaching mathematics for social justice, a belief consistent with that of mathematics for social justice advocates (Gutstein, 2006; Gutstein & Peterson, 2005). As Turner and Font Strawhun (2005) noted, “We found that creating space for students to pose their own problems and to inject their interests and concerns into the curriculum was a powerful way of supporting student activism” (p. 87).

The teachers began to consider ways that their teaching could be informed by the ideas and activities that we were discussing and using in our group. Reina’s written reflections are an indication of this awareness. She began to shift her writing toward ways she could incorporate the ideas and activities she was learning about in the group. She stated in her written reflection after the fourth session, “I feel [my teaching] would look more like a way to use the math to make arguments about our point of view...possibly at the end of a math unit as a project where the students can now use the math topics we’ve learned to hold roundtable discussions on a specific social issue.” In another reflection, she noted, “I would really love to work in a school where I could tie this into their social studies classes, where we do the investigations in mathematics and they talk about the social impacts in their social studies classes.”

This second quote hints at the struggle that all but one (Nyo) of the teachers expressed facing. These teachers dealt with their belief that engaging students in examining social injustices is a worthwhile endeavor while feeling simultaneously tied by a school culture that focuses on standardized exams the students are required to take as well as a curriculum implemented through an often rigid pacing guide. Reina was so affected by the group and the identities of being a mathematics teacher and agent of change that she struggled with her role as a high school mathematics teacher at Urban High. By her session 9 reflection, Reina spoke of the frustration she was feeling as she noted that participation in the group “made me very angry about how mathematics is currently taught.”

As she did not feel she could teach mathematics in a relevant, meaningful way, Reina explained in her exit interview that she was considering leaving the school or teaching in general. She explained why in her session 9 reflection:

To make math relevant, to create students who are socially active in what occurs in their lives feels like a huge responsibility. I have always done what was required because it was required. To create for my students something I never needed for myself seems like too much of a stretch on top of everything else that is expected of a teacher. The thought is very overwhelming.

By the time her exit interview was scheduled, Reina had decided to continue teaching but to do so at the middle school level as she had done prior to her work at Urban High. She felt that the middle school curriculum allowed her more freedom to address issues that her students were facing through mathematics.

At the start of the study, the teachers feared that examining social issues would serve not to empower students but to paralyze them into inaction as they considered the many injustices that they must face. Ellen noted in her reflection after the eighth session, “as a participant in a research group on social justice, I often worried that making students aware of the injustices they are faced with would cause them to throw in the towel or take on an attitude of self-defeat.” Throughout the course of our sessions, the teachers’ concerns about this issue began to lessen. In that same reflection, Ellen continued to say that now she realized, “students are fully aware of the injustices they face each day, and all they need is some empowerment, backing, and the means to have their issues addressed.” Many teachers echoed Ellen’s sentiment, noting that increasing awareness alone was not helpful to students and that opportunity for action, where students could exercise their agency, must accompany such work.

The participants’ desire for student empowerment and action as part of teaching mathematics for social justice is consistent with research that posits that activities around mathematics for social justice should include opportunities for action (Gutstein, 2006; Gutstein & Peterson, 2005). As a result, many were drawn to an article by Turner and Font Strawhun (2005), which described a project where students used mathematics to explore the space allotted to them as a small school housed in a larger building with other schools. The students in Turner and Font Strawhun’s study compared their space with that of the other schools and used their findings to support their argument that they were not given a fair amount of space in the building. What the teachers in the study were most drawn to in this project was that it ended with students presenting their findings to the school board in an attempt to change the situation and rectify the injustice being committed against them.

Although the teachers began to consider how to incorporate social issues and the activities we did into their classes, they were highly discriminating about what they would and would not be comfortable bringing into their classes. Some, most notably Nyo and Vanessa, felt that students will be engaged in mathematics because of the draw of these social issues and that this is a way of hooking students. Nyo wrote in reference to some of the activities we did, noting, “I loved the

use of the cartoons that illustrated political issues and how it tied into the data that were later handed out. [It was a] great introduction to the hardcore math topics.” She claimed that connecting mathematics to social issues might make the mathematics more meaningful and exciting to students. She added, in a reflection written after the ninth session, “Oddly enough I never liked social studies in school, but I feel if it were presented and related to math in a similar fashion I might have enjoyed it.” The findings discussed here highlight the fact that exposure to ways of incorporating social justice issues in mathematics can lead to teachers valuing such work and reconsidering the ways in which they teach their students, as well as the way in which they define what it means to be a teacher of mathematics.

Mathematics for social justice activities were met with interest, though not always with full support. Specifically, the teachers worried if raising awareness about social issues would serve to paralyze rather than motivate students, highlighting the need to provide avenues for action along with such lessons as argued by the research literature (Gutstein, 2006; Gutstein & Peterson, 2005). The teachers raised numerous other concerns as well, including the fact that teaching mathematics for social justice might not be supported by the school’s administration or by parents. These concerns mirrored those described by the teachers in the study conducted by Gau (2005). Thus, in order that teachers are able to implement mathematics for social justice lessons into their teaching in a meaningful way, they must be supported and taught ways in which they could provide avenues for action to follow mathematics for social justice lessons if these lessons are to be used as a catalyst for social change and not merely a way to raise awareness that on its own might not be as beneficial to students.

Participation in the group also led to changes in how the participants (and me) saw themselves (and myself). Consistent with the work of Gau (2005), the teachers’ conceptions of their roles as mathematics teachers expanded as a result of their exposure to the teaching of mathematics for social justice. They began to reconsider what it meant to teach mathematics and what counts as mathematics in the classroom. The study found that providing a forum to learn about the teaching of mathematics for social justice led to the teachers’ growing understanding of teaching as a political act, as well as the power of mathematics to be used as a critical tool for analyzing social life.

Finally, as I considered issue of power and responsibility among the teachers and me in the group sessions, I noticed that the sessions during which we worked on the unit, unlike the others, were not planned out ahead of time. In the outline of group sessions that the teachers received at our first meeting, these sessions simply listed “work on project” for the main activity to be done and I did not consciously think through or plan out how this work would be done. This omission might account for why the teachers were able to take responsibility for these latter sessions. Taking responsibility for one of the earlier sessions would

have meant disrupting the plan I had conceived and laid out for us in the session overview. That is much more challenging than taking responsibility for the working session because these were not planned prior and taking ownership of them would not necessitate a rejection of the plans I had already developed.

These realities with respect to the level of participation in our group sessions highlight to me a need for professional development to be carefully structured to include avenues for participants to take both ownership of the work and responsibility for the development of the professional development experience. Ownership is defined as, “our ability to take responsibility for negotiating meaning” (Wenger, 1998, p. 201). That is, opportunities are created for teachers to come to an understanding of the materials or methods, to bring in their points of view and experiences, and to impact what occurs as part of the professional development. Given opportunities to truly engage in the material, teachers are more likely to value the professional development and more likely to use what they learn than if they are treated as mere receivers of information.

Implications, Unanswered Questions, and Issues for Further Research

This study was informed by, and hopefully adds to, the research literature in the teaching of mathematics for social justice and teacher development through communities of practice. The conclusions reached can inform future professional development programs, hopefully leading to improved experiences for teachers, and through them, for students as well. Lessons learned about the developing identities of the participants can serve to inform future studies and also programs aimed at pre- and in-service teacher development.

Although my study added to the research in the areas specified above, it left unanswered questions that can serve to guide further research. Answering such questions might provide valuable insight into a number of topics, including the teaching of mathematics for social justice, professional development through a community of practice, and teacher pedagogy. The focus here is on teachers’ developing understandings of teaching mathematics for social justice and the effects of participation in the group on teachers’ identities as agents of change. Both of these are pre-cursors, or necessary conditions, for changes in teacher action leading to pedagogical shifts. Following these teachers into their classrooms to determine how these changes in understandings and identity impact teacher’s actual practice is a logical next step that might lead us to answer questions such as:

- Does participation in a community of practice centered on teaching mathematics for social justice change teachers’ pedagogical practices? If so, in what ways?

Another area for further research involves studying the ways that teachers could be supported so that they move from understanding mathematics for social justice to implementing it in their classrooms. Examining ways that teachers could be supported as they move from awareness to implementation seems an invaluable endeavor. Any reform, in order to be successful, requires support from the school, and so while we see work on preparing teachers to teach mathematics for social justice, an example of which is this very study, I continue to wonder:

- What resources does a school and/or administration staff need to provide in order that teachers might fully implement mathematics for social justice lessons into their teaching?

Another factor to further explore would be how the findings might have differed if the professional development group and the study as a whole were undertaken with teachers who were not necessarily all aligned with the goals of teaching mathematics for social justice from the start or with teachers whose political and social understandings were less congruous than those of the participants in this study.

- How would the group and the experience in general for teachers have been different if their opinions on various social issues were not so closely aligned?

These are very rich questions that I believe are valuable ways of focusing future research—my own included.

Before concluding, I would like to share a quote from a reflection written by Nyo after the fourth session that I think speaks to the excitement that I, the teacher participants, and hopefully some of you reading this article feel about teaching mathematics for social justice: “I absolutely liked the idea of mathematizing everything around us.”

Acknowledgments

This article is based upon work partially supported by the National Science Foundation (NSF) under Grant No. ESI-0333753. Any opinions, findings, and conclusions or recommendations expressed in this article are those of the author and do not necessarily reflect the views of the NSF.

References

- Apple, M. (1992). Do the standards go far enough? Power, policy, and practice in mathematics education. *Journal for Research in Mathematics Education*, 23, 412–431.

- Aronowitz, S. (2004). Against schooling: Education and social class. *Social Text* [79], 2(2), 13–35.
- Brantlinger, A. (2007). *Geometries of Inequality: Teaching and researching critical mathematics in a low-income urban high school*. Unpublished doctoral dissertation, Northwestern University, Evanston, IL.
- Brantlinger, A., Gutstein, E., Buenrostro, P., & Turner, E. (2007). *Teaching mathematics for social justice: Is there math there?* Paper presented at the Annual Meeting of the National Council of Teachers of Mathematics, Atlanta, GA.
- Burton, L. (Ed.). (2003). *Which way social justice in mathematics education?* Westport: Praeger.
- Choi, M. (2006). Communities of practice: An alternative learning model for knowledge creation. *British Journal of Educational Technology*, 37(1), 143–146.
- Coti, C. (2005). Finding myself in my students: A step toward transforming social dynamics in the classroom. In L. Darling-Hammond, L. French, & S. P. Garcia-Lopez (Eds.), *Learning to teach for social justice* (pp. 52–58). New York: Teachers College Press.
- Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Upper Saddle River, NJ: Pearson Education.
- Darling-Hammond, L., French, L., & Garcia-Lopez, S. P. (Eds.). (2002). *Learning to teach for social justice*. New York: Teachers College Press.
- Florio-Ruane, S. (2001). *Teacher Education and the Cultural Imagination: Autobiography, conversation and narrative*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Frankenstein, M. (1983, Fall). Critical mathematics education: An application of Paulo Freire's epistemology. *Boston University Journal of Education*, 165(4), 315–359.
- Freire, P. (1993). *Pedagogy of the oppressed*. New York: Continuum. (Original work published 1970)
- Gau, T. (2005). *Learning to teach for social justice*. Unpublished doctoral dissertation, University of Wisconsin, Madison, WI.
- Gonzalez (2008). *Mathematics teachers as agents of change: Exploring teacher identity and social justice through a community of practice*. Unpublished doctoral dissertation, Graduate Center of the City University of New York, NY.
- Gutiérrez, R. (2007). (Re)Defining equity: The importance of a critical perspective. In N. S. Nasir & P. Cobb. (Eds.). *Improving access to mathematics: Diversity and equity in the classroom*. (pp. 37–50). New York: Teachers College Press.
- Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. New York: Routledge.
- Gutstein, E. (2008). *Reinventing Freire: Mathematics education for social transformation*. Proceedings of the Fifth International Education and Society Conference, 9–24. Albufeira, Portugal.
- Gutstein, E., & Peterson, B (Eds.). (2005). *Rethinking mathematics: Teaching social justice by the numbers*. Milwaukee, WI: Rethinking Schools.
- Holland, D., Lachiotte, W., Jr., Skinner, D., & Cain, C. (2003). *Identity and agency in cultural worlds*. Cambridge, MA: Harvard University Press.
- Martin, D. B. (2000). *Mathematics success and failure among African-American youth: The roles of sociocultural context, community forces, school influence and individual agency*. Mahwah, NJ: Laurence Erlbaum Associates.
- Martin, D. B. (2003). Hidden assumptions and unaddressed questions in the *Mathematics for All* rhetoric. *The Mathematics Educator*, 13(2), 7–21.
- McLaren, P. (2000). *Che Guevara, Paulo Freire, and the pedagogy of the revolution*. New York: Rowman & Littlefield.
- Michelli, N. M., & Keiser, D. L. (Eds.). (2005). *Teacher education for democracy and social justice*. New York: Routledge.

- Moses, R. P., & Cobb, C. E., Jr. (2001). *Radical Equations: Civil rights from Mississippi to the Algebra Project*. Boston: Beacon Press.
- Mukhopadhyay, S., Powell, A. B., & Frankenstein, M. (2009). In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.) *Culturally responsive mathematics education*. (pp. 65–84). New York: Routledge.
- Nasir, N. S., Hand, V., & Taylor, E. (2008). Culture and mathematics in school: Boundaries between “cultural” and “domain” knowledge in the mathematics classroom and beyond. *Review of Research in Education, 32*, 187–240.
- National Center for Educational Statistics. (n.d.). School and staffing survey. Retrieved on September 5, 2008, from <http://nces.ed.gov/surveys/sass>
- New York City Department of Education. (n.d.) Homepage. Retrieved on May 26, 2007, from <http://schools.nyc.gov>
- New York City Department of Education. (2006). New York State School Report Card and Accountability Overview Report. Retrieved on May 26, 2007, from <https://www.nystart.gov/publicweb/Home.do?year=2007>
- Rorty, R. (1979). *Philosophy and the mirror of nature*. Princeton, NJ: Princeton University.
- Roth, W.-M. (2005). *Doing qualitative research: Praxis of method*. Rotterdam, NL: Sense.
- Sleeter, C. E. (1997). Mathematics, multicultural education, and professional development. *Journal for Research in Mathematics Education, 28*(6), 680–696.
- Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. London: Sage.
- Tate, W.F. (1995). Returning to the root: A culturally relevant approach to mathematics pedagogy. *Theory Into Practice, 34*, 166–173.
- Tate, W. F. (2005). Race, retrenchment, and the reform of school mathematics. In E. Gutstein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers*, (pp. 31–40). Milwaukee, WI: Rethinking Schools.
- Turner, E. E., & Font Strawhun, B. T. (2005). “With math, it’s like you have more defense” In E. Gutstein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers*, (pp. 81–87). Milwaukee, WI: Rethinking Schools.
- Villegas, A. M., & Lucas, T. (2002). *Educating culturally responsive teachers: A coherent approach*. Albany, NY: State University of New York Press.
- Wenger, E. (1998). *Communities of Practice: Learning, meaning and identity*. Cambridge, UK: Cambridge University Press.
- Zollers, N. J., Albert, L. R., & Cochran-Smith, M. (2000). In pursuit of social justice: Collaborative research and practice in teacher education. *Action in Teacher Education, 22*(2) 1–14.