The Nuances and Complexities of Teaching Mathematics for Cultural Relevance and Social Justice

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Journal of Teacher Education 2010 61: 261 originally published online 11 March 2010
DOI: 10.1177/0022487109359927

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Journal of Teacher Education
61(3) 261–270

DOI: 10.1177/0022487109359927
http://jte.sagepub.com
SAGE

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Abstract

Mathematics is not a race-neutral subject. Access and opportunity in mathematics for students of color in the United States continue to be limited. While a great deal of attention has been given to increasing the number of underrepresented minority students in the mathematics pipeline, there is little consideration of who they are as learners or the context in which their mathematics learning takes place. We argue that culturally relevant instruction coupled with teaching for social justice can motivate marginalized students to learn mathematics. Throughout this conceptual article, we (a) explore the theoretical frameworks underlying culturally relevant pedagogy (CRP) and social justice pedagogy (SJP), (b) present illustrative cases of mathematics teaching that reveal the possibilities and challenges associated with these pedagogical approaches, and (c) offer to the field of teacher education recommendations related to the successful use of CRP and SJP within today's classrooms.

Keywords

critical theory, critical pedagogy, mathematics education, teaching context, multicultural education

Throughout this article, we argue that culturally relevant and social justice instruction can offer opportunities for students to learn mathematics in ways that are deeply meaningful and influential to the development of a positive mathematics identity. We also acknowledge, however, that to be effective, these approaches require teachers to carefully reflect on, attend to, and pedagogically plan for the nuances and complexities inherent in concepts such as culture and social justice. Culturally relevant and social justice teaching as educational practices have been important discourses in education for more than a decade (Frankenstein, 1995; Gonzalez, 2009; Gutstein, 2006; Ladson-Billings, 1994). We pair these instructional frameworks because alone neither can fully address major shortcomings in the mathematics classroom. Some scholars, for instance, recognize these pedagogies as ways of motivating marginalized students to engage in mathematics as they grapple with inequitable and oppressive influences in their own lives (Gonzalez, 2009; Gutstein, 2006; Leonard, 2009; Martin, 2009). Other scholars, such as de Freitas (2008), claim that "addressing social justice issues should be a primary goal of all education—including mathematics education" (p. 43).

Notwithstanding the increased scholarly interest in these frameworks, curriculum standards and/or benchmarks, including the *Principles and Standards* document of the National Council of Teachers of Mathematics (NCTM, 2000), that have been written to guide teachers' mathematics instruction do not offer suggestions for teaching mathematics with cultural relevance and social justice in mind. A conceptual review of these literatures may well bring added attention to these approaches within and outside of academe. The goals of this article are threefold: (a) to explore the theoretical frameworks underlying culturally relevant pedagogy (CRP) and social justice pedagogy (SJP), (b) to present illustrative cases of mathematics teaching that reveal the possibilities and challenges associated with these pedagogical approaches, and (c) to offer to the field of teacher education recommendations related to the successful use of CRP and SJP within today's classrooms.

Learning Mathematics: Cultural and Critical Theories Considered

To explicate CRP, SJP, and their theoretical underpinnings, we begin by defining and describing the role of culture in learning. Tillman (2002) defines culture as "a group's

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individual and collective ways of thinking, believing, and knowing, which includes their shared experiences, consciousness, skills, values, forms of expression, social institutions, and behaviors" (p. 4). Mathematics, like all other forms of knowledge, is situated within a cultural context (Lave & Wenger, 1991; Nasir, Hand, & Taylor, 2008). For example, counting is not a neutral exercise because it serves as a way to quantify objects, in some cases to determine value, and to develop one-to-one correspondence. Consequently, counting can be conceptually understood as both a knowledge form and a cultural practice that enables students to organize their world (Tate, 2005). CRP encourages teachers to view and employ cultural practices as forms of official knowledge (Ladson-Billings, 1995). Engaging cultural norms in the classroom is at the heart of teaching for cultural relevance. Though teaching for cultural relevance may be conceived as different from CRP, as constructs both ideas rest on the same principles and goals. As such, these terms are used interchangeably in this article.

Specifically, CRP supports the following three goals for students: (a) academic success, (b) cultural competence, and (c) development of critical consciousness (Ladson-Billings, 1994, 1995). Academic success is more than the acquisition of minimal skills to function in society at large; it is acquiring the tools to become a lifelong learner. Cultural competence is "the ability to function effectively in one's culture of origin" (Ladson-Billings, 2000, p. 210). Cultural competence reflects knowledge, beliefs, and attitudes that are both participatory and transformative. Critical consciousness is the ability to understand the political nature of a situation, critique the status quo, and proactively try to change it (Ladson-Billings, 1995). When cast this way, CRP has the potential to shape a student's identity, especially in mathematics.

A mathematics identity is formed by one's belief about one's "(a) ability to do mathematics, (b) the significance of mathematical knowledge, (c) the opportunities and barriers to enter mathematics fields, and (d) the motivation and persistence needed to obtain mathematics knowledge" (Martin, 2000, p. 19). Developing a positive mathematics identity is important because mathematics education as a social construction is a gendered and racialized experience (Leonard, 2008, 2009; Martin, 2007, 2009). Based on gender and racial characteristics, students can be conditioned to believe they are not the appropriate type of math student (Stiff & Harvey, 1988). For example, Black students may be reluctant to ask questions in mathematics class or perform a difficult task because of concerns about teachers forming unfavorable perceptions of them or their ethnic group (Morris & Monroe, 2009).

Like CRP, teaching for social justice has strong theoretical roots traced to the work of Paulo Freire (Apple, 2003). Freire's most well-known theoretical construct asserts the necessity of viewing the world "through the eyes of the oppressed" (Apple, 2003, p. 108). His conception of *conscientização* theorizes a critical reading of the world to rewrite the world (Freire, 2006). This reading provides the foundation for critical pedagogy, which supports views of practice that encourage both teachers and students to develop an understanding of the interconnecting relationship among ideology, power, and culture (Preece & Griffin, 2006). An important aspect of Freire's concept of *conscientização* is a person's participation in his or her liberation. Viewing mathematics teaching as liberatory goes beyond what Gutstein (2006) has described as functional literacy and to transformative learning. In this way, greater outcomes can be expected because learners develop authority through full engagement in the learning process: a critical approach to teaching and learning.

Functional literacy focuses on teaching mathematics to prepare students for the workforce. Most often the kind of mathematics instruction students receive in this context is dependent on previously conceived ideas about their relative place in society. This kind of mathematics instruction is generally formulaic and prescriptive, characterized by giving information, asking low-level questions, giving directions, monitoring assignments, reviewing assignments, testing, punishing noncompliance, and giving grades (Haberman, 1991). In contrast, to learn mathematics through a critical stance is to examine the systems and institutions that are in place and to use mathematics to evaluate and critique these systems and institutions as well as develop individual and social agency (Gutstein, 2006). Agency develops through meaningful engagement with real problems. For example, when students in a seventh-grade class examine housing patterns to formulate opinions and address concerns about racism and classism in their community (Gutstein, 2006; Tate, 1995; Turner & Strawhun, 2005), they are participating in a social justice approach to learning mathematics; they are "involved with applying ideals such as fairness, equity, and justice to their world" (Haberman, 1991, p. 293) as lived inside of mathematics contexts.

Building on the above theoretical roots, teaching mathematics for social justice has been described as follows: (a) access to high-quality mathematics instruction for all students; (b) curriculum focused on the experiences of marginalized students; (c) use of mathematics as a critical tool to understand social life, one's position in society, and issues of power, agency, and oppression; and (d) use of mathematics to transform society into a more just system (Gonzalez, 2009). A socially just society is characterized "by equal opportunities, equal access, and the ability of all to reach their potential through all of life's opportunities" (Gonzalez, 2009, p. 26); however, the impetus for teaching for social justice should not simply be to increase participation in advanced mathematics courses, access to higher education, and entry into the workforce (Martin, 2009). Instead, the motivation for using a social justice context for learning mathematics should be informed citizenship (Moses & Cobb, 2001) and self-empowerment (Leonard, 2009; Martin, 2009; Sleeter, 1997).

The Extant Literature: CRP and SJP in the Mathematics Classroom

Building on the theoretical frames just described, we next review the extant literature on CRP and SJP. Although separated into two sections for purposes of this discussion, based on the goals of each pedagogical framework, an extensive amount of overlap necessarily occurs. In other words, studies of CRP often have aspects of SJP embedded and vice versa; however, we have organized the work below based on the dominant aspects taken up in the research. CRP leans toward the incorporation of cultural practices as ways to build on students' prior knowledge; issues of larger societal equities may not always surface. Teaching for social justice differs from teaching for cultural relevance in that SJP explicitly deals with addressing some form of hegemonic practice that results in the marginalization or disenfranchisement of a specific group of people.

CRP: Teaching and Learning

Lipka et al. (2005) conducted a study of culturally relevant instruction. The researchers were able to compare teachers' practices before and after an intervention using a quasi-experimental research design. Specifically, they analyzed teacher–student relationships, student-to-student talk, and mathematics communication among two teachers and their Yup'ik (Native Eskimo) students. In one case, the teacher's instruction was very traditional at the outset; however, when she began using Math in Cultural Context, a culturally based math curriculum designed for urban and rural Yup'ik students, the activities and discourse in her classroom changed from teacher centered to student centered. In a second case, the teacher had already adopted a student-centered teaching philosophy before the intervention. This teacher's students outscored all of the other students in the study in mathematics. Changes were connected to the teacher's relationships with her students because she created what was called a "third space" where students could develop a mathematics identity within a cultural context that valued indigenous mathematics knowledge alongside traditional mathematics knowledge (p. 369).

As shown in the above example, meaningful CRP includes the use of engaging cultural practices situated within learning communities that support student discourse and stronger teacher–student relationships. Similarly, research studies that link cultural practices to mathematics instruction reveal African American students are eager to engage in mathematical tasks when connections are made to other cultural practices such as technology (Conant, Rosebery, Warren, & Hudicourt-Barnes, 2001; Leonard, Davis, & Sidler, 2005), sports (Nasir, 2002; Nasir et al., 2008), games (Nasir, 2005), and music (Albert, 2000). For example, students had the following remarks about a culturally based computer software program: "It was fun and exciting, so different from the usual" and "The software was different. It had constellations and math and science, everything all in one packet" (Leonard et al., 2005, p. 274).

The Cheche Konnen Project (Conant et al., 2001) also used technological tools to explore the oral and literate traditions of ethnic minority children in science and mathematics. Students had choices about what they would study and actively constructed scientific understandings through collaborative investigations about problems that were interesting to them. For example, Haitian students used the computer to analyze Haitian drum rhythms. The students' own questions and interests worked together to create a rich environment for learning about sound, physics, and mathematics (Conant et al., 2001).

Nasir's (2002) study of middle and high school basketball players shows compelling results about the impact of culture on students' problem-solving ability. When the players were asked to solve the basketball problems first, they performed better on both contextualized and noncontextualized problems. When they were asked to solve the noncontextualized problems first, they performed worse on both types of problems. In this study, "the basketball players possessed knowledge about averages and percentages that was inaccessible in the math classroom and that their teachers likely did not know they had" (Nasir et al., 2008, p. 189).

In another example, Nasir (2005) examined the sociocultural context of playing dominoes on the mathematics learning of elementary and high school students. She contends that games are artifacts of culture through which individuals learn cultural roles, community values, and cultural knowledge. Such artifacts reflect and work to reproduce culture, which begins to shape individual lives early in infancy. The participants in Nasir's study included 20 fourth graders and 32 tenth graders. Findings revealed fourth-grade students did not simply compute the mathematics required for the game, but they learned what to count and where to place the dominoes to earn maximum points. In other words, students did mathematics for a purpose, learning how to match the dominoes and under what conditions. High school students engaged in even more sophisticated play, such as scaffolding their partners' learning, blocking, and creating new norms for play. Nasir concluded that mathematics does not stand alone as a separate set of operations and skills but supports cultural practices and motivational goals that students bring to the table. In other words, learning mathematics is not divorced from the goals of the individual or the learning community (Frankenstein, 1983).

Notwithstanding the research mentioned above, a study of two secondary mathematics teachers describes how the context of ordering fast food from McDonald's to engage predominantly Black English for Speakers of Other Languages (ESOL) students in a culturally relevant task is not as straightforward as it appears. Although nutritional facts about fast food were presented in the movie *Super Size Me* (Spurlock, 2004), student interest was low because they did not

participate in the McDonald's fast food culture. Instead of enhancing students' knowledge, the McDonald's context became a barrier that limited their engagement in rigorous mathematics content and did little to capitalize on their backgrounds and experiences. Language and cultural barriers affected some of these Black ESOL students' development of the vocabulary and discourses (i.e., mathematics register) needed for success (Moschkovich, 2002). This example considers how math teachers engaged in CRP training responded to their own learning process. As a result of their CRP project, two mathematics teachers shared the following epiphany:

> A culturally relevant project is not culturally relevant in itself; you really need to know the students you will be working with so that the context is really culturally relevant for them. (Teacher C, March 2008)

> We now believe "less is more." That is, from our point of view, we should try to accomplish less mathematical objectives in each session so as to give time to connect the data with the context and give more meaning to the mathematical constructs in terms of the context of the problem. (Teacher K, March 2008)

Clearly, these teachers' reflections reveal they learned a great deal about CRP by doing it. The way teachers reflect on their lessons' effectiveness is vitally important when it comes to implementing CRP in the classroom (Leonard, Napp, & Adeleke, 2009). In this study, using an unfamiliar cultural example limited students' learning.

SJP: Teaching and Learning

Similar to CRP, SJP allows students from all backgrounds to engage in meaningful mathematics while developing a mathematics identity (Gonzalez, 2009; Gutstein, 2006). SJP can be used in mathematics classrooms to help students interpret and apply mathematical knowledge to answer questions that will potentially empower their lives and their communities. Gutstein (2006) contends that "students need to be prepared to investigate and critique injustice, and to challenge, in words and actions, oppressive structures and acts," which he calls learning how to "read and write the world" with mathematics (p. 4). From issues related to differences in property values among diverse neighborhoods based on race and ethnicity (Gutstein, 2006) to unfair mathematical representations of the achievement gap (Martin, 2007, 2009), the literature has demonstrated that mathematics can be used to expose inequities and unfair practices and lead to important policy changes (Leonard, 2009; Martin, 2009). Teaching mathematics for social justice can also empower marginalized students to change the status quo and not merely fit into it (Ladson-Billings, 1994). Helping students to develop critical mathematics literacy empowers them to use mathematics to accomplish their own ends and purposes (Martin, 2000).

Proponents of SJP emphasize that mathematical power gives students of color the opportunity to voice objections to discriminatory practices and call into question actions that disadvantage them while privileging others (Tate, 1995; Turner & Strawhun, 2005). For example, Tate (1995) described a classroom project in which African American students used data to confront their city council on the disproportionate number of liquor stores operating in their neighborhood. In another case, African American and Caribbean students used critical mathematics literacy to bring attention to overcrowded conditions in their school compared to another school with a less diverse student population that was operating in the same building (Turner & Strawhun, 2005). Both of these cases are examples of teaching for social justice. Students learned not only mathematics but also self-empowerment.

Teaching for social justice requires teachers to scrutinize their identities—personal identity, teaching identity, and identity as an agent of political change (Gonzalez, 2009). This is especially true because of the often volatile context of school reform. Gonzalez (2009) reported on a study of seven secondary mathematics teachers and how their approaches to SJP changed as a result of professional development. As the teachers participated in a "community of practice" during the professional development course, they were better able to see how an empowering school structure could be enacted in their own classrooms (Gonzales, 2009, p. 43). These secondary teachers acknowledged how SJP could be enhanced in their classrooms, but few were willing to resist administrative demands and high-stakes testing. Because of these constraints, one teacher left the high school to teach in a middle school where she believed she could engage in SJP more easily. By the end of the professional development course, teachers understood how discussion and reflection could help high school students find their voice. "Having students realize their [own] agency by working towards social change was seen as a way of combating learned helplessness" (p. 45).

In another study of teacher interns enrolled in a graduate-level mathematics teacher education course, interns learned that culturally relevant approaches could be used to link mathematics to SJP (Leonard & Evans, 2008). Six teacher interns participated in a study that allowed them to participate in community-based field experiences. By exposing teacher interns to these informal school settings, the researchers aimed to reduce stereotypes about urban students and provide opportunities to field test some of the assumptions they found in the social justice literature with real students in actual classrooms. One teacher intern's reflection is presented below:

> It seems as if my undergraduate education in sociology has laid the groundwork for a deeper and more applicable understanding of social justice and equity, which I have been able to build upon both in theory and in practice. Ultimately, my understanding of culture in

> mathematics education will be tested in the classroom, and that is why my experience at Zion this semester has been so valuable. While the context that children are raised in may not be the sole determining factor of their success, it undoubtedly will impact the rest of their lives. Students who have limited access to resources and effectual education will have limited opportunities to achieve. This reality is clearer after one day at Zion than it could ever be in a journal article or textbook.

The results of the study reveal that teaching mathematics for social justice cannot be learned in a vacuum. It is important for preservice and beginning teachers to see SJP in practice (vicarious experiences) and have opportunities to learn from their practice (master experiences) to increase their self-efficacy (i.e., beliefs about their ability to teach the subject matter; Bandura, 1997). The extant literature has a paucity of examples of CRP and/or SJP in practice. We present the following case studies to add to the literature base.

Case Studies of Mathematics Teaching

Examples of CRP coupled with SJP in everyday mathematics classrooms are sparse in the extant literature. The text titled *Rethinking Mathematics: Teaching Social Justice by the Numbers* (Gutstein & Peterson, 2005) is one of the few to provide narratives that illustrate teachers' attempts to engage in SJP. We present our examples of CRP and SJP to help preservice and beginning teachers understand the nuances and complexities of teaching from these stances. These examples of mathematics teaching focus on four topics: (a) problem solving and the Underground Railroad, (b) algebra and the displacement model; (c) geometry, resource allocation, and South Central Los Angeles, and (d) calculus and the distribution of wealth. These examples were selected because they are data rich. First, the students described in each case cut across racial, grade, and class backgrounds. The schooling contexts range from public to public charter to private. Furthermore, each case reveals a purposeful attempt at exposing students to deep and meaningful mathematics; however, throughout the examples, the teachers experience a range of the possibilities and challenges inherent in the approach. As a result, the complexities of teaching from these frameworks come through. There is no silver bullet. Although aspects of CRP and SJP are present in all of the cases, each example leans a bit more toward one as it gets augmented by the other.

Problem Solving: Quilting and the Underground Railroad (Case Study 1)

Two fourth-grade teachers at a high-performing Philadelphia charter school participated in a study to infuse CRP in their reading and mathematics lessons. The project, funded by the National Science Foundation, supplied the teachers with texts and a CD-ROM designed to capture students' problem-solving ability around the topic of the Underground Railroad. Children's literature included *Sweet Clara and the Freedom Quilt* (Hopkinson, 1993), *Freedom River* (Rappaport, 2000), and *Aunt Harriet's Underground Railroad in the Sky* (Ringgold, 2002). Both teachers used quilts to help students learn important mathematics concepts such as perimeter and area. Students in Ms. Baker's (pseudonym) class made eight patches to contribute to a classroom quilt and shared a story about the meaning of their patches. Ms. Baker made the following comment about the activity:

> One student who had recently become sullen in the classroom made his entire quilt of patches about his grandfather who had recently passed away, and I remember his mother cried when I showed it to her. The caption read, "R.I.P. Chief" and had an illustration of the grandfather on the quilt. . . . I was happy to see that many students had created one or more patches with the school or an image of him/her learning in the classroom. I saw that the quilts were another way that students could be expressive about their own lives, learning about their culture and history, and learn important content such as mathematics simultaneously. (Leonard, 2008, p. 97)

The quilting lesson, which was integrated with children's literature, did more than provide a context for these fourth-grade students to learn mathematics. Although they remembered the concepts of perimeter and area long after the activity, it allowed them to have a voice in the classroom. That voice was an artistic and literary voice that told their personal stories about triumphs and tragedies. Ms. Baker was moved by the poignant events in her young students' lives and how these events affected their learning. She was culturally responsive to her students, built a learning community, and provided a third space where students could connect their identities to the content (Lipka et al., 2005). The quilting lesson also focused on the first civil rights movement: the Underground Railroad. Thus, a connection was made to social justice as students learned how one person like Harriet Tubman could make a difference in the lives of others.

Algebra: The Displacement Model (Case Study 2)

Robert Moses (Moses & Cobb, 2001) developed the displacement model (one of quantity and direction) to help children understand the difference between arithmetic and algebra. In arithmetic, problems tend to focus on "how much" or "how many," whereas algebra focuses on "how many" and "which way" (Moses & Cobb, 2001, p. 200). From this seminal work, the Algebra Project evolved. The Algebra Project has been successful with African American students who were observed using number lines and coordinate grids to learn about quantity and direction. For example, the following problem was presented to students: "In what direction and

how many stops is Park Street Station from Central Square?" (Moses & Cobb, 2001, p. 200). The answer can be understood as displacement (i.e., three stops inbound). After some practice, students are able to use symbols to notate the displacement as positive or negative. When two directions are used, students are introduced to the coordinate plane. Cultural relevance comes into play when the example used relates to the students' lived experiences—the students' culture. For example, teachers can adapt this lesson by using Google Maps to find their students' neighborhood and use it as the context for learning. The distance and direction from a student's home to school can be represented by counting the number of blocks east or west on the x-axis and north or south on the y-axis. Students can then represent the change in x and the change in y as quantities. Furthermore, students can learn the concept of slope as they examine the line that results from using their home as Point A and the school as Point B to find the rise over the run. In addition, concepts of latitude and longitude with specific degree measures can be used to differentiate the instruction further. Teachers can develop a plethora of problems that are culturally specific to the students in their classroom, engage appropriate technologies, and then help those students to transfer their knowledge to more general types of algebraic problems.

Geometry: Resource Allocation and South Central LA Lesson (Case Study 3)

Brantlinger (2005) linked cultural relevance and social justice to a mathematics lesson when he taught a group of high-poverty students in the Midwest. In his mathematics lesson, Brantlinger used Google Maps, scaling, measurement, and geometry to help students from a working-class community investigate the number of community centers and movie theaters within a 3-mile radius of South Central Los Angeles, an urban but working-class community like their own. Such exercises help students to develop a mathematics identity because the mathematics that is being presented is connected to spaces where actual people live and work.

This lesson is revealing because it simultaneously attended to cultural relevance, social justice, and rigorous mathematics, which can be problematic for some teachers. In Brantlinger's class, students derived a formula to determine how many city blocks were within the 3-mile radius. Then data were analyzed for community resources. Brantlinger's students found there were no community centers and no movie theaters in the South Central location they investigated; however, they found an overabundance of liquor stores in South Central neighborhoods. The point Brantlinger tried to make was that different communities have different levels of resources based on economic status. Any city or town in the United States could have been used.

Although they, too, were from disadvantaged backgrounds, a few students exhibited insensitivity toward students from South Central stating, "All they want to do is drink!" (Brantlinger, 2005, p. 99). Although this lesson did not intend to reinforce stereotypes, some students in Brantlinger's class drew conclusions that "reinforced the dominant view that the problem with South Central is the people who live there" and not the systemic issues that affected their quality of life (Brantlinger, 2005, p. 99). To help the students understand racial and social positioning and the advantages and disadvantages of living in certain zip codes, the teacher could have encouraged students to examine resource allocations in their own neighborhood and compare them to a more affluent neighborhood nearby. After first exploring data drawn from the communities with which the students were familiar, students may have been able to make the social justice connection Brantlinger intended with the South Central example. Furthermore, he could have balanced his students' perspectives by sharing examples such as the one in Tate's (1995) study where poor minority students were proactive in trying to rid their neighborhoods of liquor stores.

Calculus: The Distribution of Wealth Lesson (Case Study 4)

Staples (2005) taught students in an AP calculus class at a prestigious boarding school about disparities in wealth in the United States. She presented students with data and statistics that outlined the stark differences in income among affluent families and families at or below the poverty line. For example, tuition at the private school was more than high-poverty families made in a year. The lesson engaged students in rigorous mathematics as they disaggregated data. Several students showed they truly understood income differences when the data were presented by exclaiming, "Whoa!" On the other hand, it was difficult for Staples's (2005) students to grapple with the fact "that the top 20 percent of households held 47 percent of the wealth" (p. 104). Students had difficulty understanding the advantages and privileges of their high socioeconomic status.

Given Staples's reflection, we conclude that it is difficult for students to grasp social justice concepts in one lesson. These students' identities and limited experiences with students in a social class different from their own contributed to them remaining "unaware of their positions in the [political] landscape" (Staples, 2005, p. 106). Students had difficulty seeing how their privileged positions in the elite school allowed them to participate in the social reproduction of class in the United States (de Freitas, 2008). Such a topic was indubitably uncomfortable for the teacher and the students. Nevertheless, the "pedagogy of discomfort" is needed to engage in critical dialogue (de Freitas, 2008, p. 46).

To help students in elite educational settings develop critical consciousness, teachers might extend Staples's lesson to examine the costs of a social program such as Medicare or national health care compared to tax loopholes for the

wealthy. Frankenstein (1983) provided an example of this by comparing data on Aid to Dependent Children for an average family of four in 1975 ($5,000) to the tax loophole for the richest 160,000 taxpayers during the same period ($45,000). Helping students to use mathematics to understand issues such as these empowers them to use mathematics for a purpose and to develop critical consciousness. Gutstein (2006) provides two salient examples where middle school students from working-class backgrounds were able to develop an understanding about the distribution of wealth:

> In the U.S., Bill Gates holds more money than anybody else, but if you divide the wealth by population, Bill would probably have an average amount of money and a homeless [person] would have an average amount of wealth. (Gutstein, 2003, p. 50)

> Our family makes somewhere in the neighborhood of $40,000. I heard that Michael Jordan makes about $1,000 for every minute he plays. So that means that in 40 minutes he makes our whole family's earnings. While my family works year round for that money. (Gutstein, 2003, p. 50)

Both of these examples reveal not only students' deep understanding of mathematics but also their identities and racial and social positioning (Dutro, Kazemi, Balf, & Lin, 2008). The second student specifically compares Michael Jordan's wealth to that of his family's annual income, explaining Jordan's wealth in terms that the students in his class could understand. In this case, mathematics became a vehicle for examining power relations in the form of resource allocation. Likewise, students from more affluent backgrounds should engage in similar exercises to understand the complexities of resource allocation in a democratic society. Thus, students from diverse socioeconomic backgrounds can learn about the rich family traditions and cultural capital students from different socioeconomic groups possess.

Conclusions and Recommendations for Teacher Educators

Finding appropriate examples of culturally relevant instruction with social justice aims can be a challenge for mathematics teachers. Teachers are likely to exit credentialing programs without this knowledge (Blanchett, 2006), and inservice teachers often receive little professional development on how to infuse student culture and social justice issues into their everyday mathematics routine (Leonard et al., 2009). Having said this, we realize that teaching mathematics for cultural relevance and social justice is a complex enterprise that cannot be separated from the social and political forces that affect education and society (de Freitas, 2008; Frankenstein, 1983).

CRP and SJP cannot be prescribed or scripted. We recommend that preservice teachers be provided with ample opportunities to see CRP and SJP modeled in methods courses as well as opportunities to apply and reflect on their own practice in field experiences. Teacher educators can use such experiences as a springboard to discuss the nuances of CRP and SJP in their methods courses. It is important for preservice teachers to understand the complexities of these pedagogical approaches especially if CRP and SJP are paired. To ensure lessons are meaningful to the students they teach, teachers should become students of students to learn what topics may motivate their students to learn (Nieto, 2002). Teacher educators can help preservice teachers become more cognizant of students' culture by asking preservice teachers to reflect on their own cultural background (Ladson-Billings, 2000). Helping prospective teachers to develop "narrative identity" (de Freitas, 2008, p. 53) as they reflect on their educational histories and field experiences in methods courses is essential to developing pedagogies that use culture and social justice as a basis for teaching and learning mathematics.

Novice teachers who choose to engage in CRP and SJP should not be judged by one or two attempts. Beginning teachers have to learn from their practice and reflection to become experts. Such practice is crucial to understanding the teaching and learning process in educational spaces where the lives of teachers and students from different cultural, ethnic, and socioeconomic backgrounds intersect (Nasir et al., 2008). This means that teachers must understand the cultural, social, political, and economic contexts that affect the lives of students and then mathematize these contexts.

Teaching for cultural relevance and social justice is not a panacea (Ladson-Billings, 1998). Teachers must be careful to avoid essentializing any one dimension of this model or adopting any one set of practices—that is, assuming one size fits all. The assumption that these pedagogies are beneficial to students is tied to how teachers theoretically perceive culture and social justice.

Regarding CRP, no culture is monolithic. Every culture consists of multiple subcultures. It has been suggested that teachers draw on the multiple facets of students' culture to make connections to mathematics (NCTM, 2000), yet roadblocks exist. These include the incorporation of narrow conceptualizations and irrelevant examples that do not lead to positive student identity, independent learning, mathematical empowerment, and development of critical thinking. Care must be taken not to trivialize or routinize culture in the mathematics classroom to the extent that it becomes counterproductive or just another form of hegemonic practice (Ladson-Billings, 1998). Although there is a common set of sociohistorical experiences that connect students of particular backgrounds together, neither the students nor their needs remain the same over time. Tapping into students' cultural capital and practices requires teachers to examine students' individual identities and subcultures (Hill, 2006; Moschkovich, 2002).

Obstacles also exist when certain social justice approaches are not carefully thought through. A major obstacle that must be acknowledged is what Freire calls the "culture of silence" (Frankenstein, 1983). The culture of silence occurs when teachers participate in social injustice themselves or fail to critique students who perpetuate inappropriate stereotypes. Teaching for social justice should instill students with new knowledge of the world as it should be to reconstruct society and lead to social change. A major premise is that teachers who embrace SJP empower students to use their own personal and cultural knowledge stores (Banks, 1993) as they find new applications and make new meanings—"making conjectures, developing arguments, investigating ideas, justifying answers, validating [their own] thinking" (Gutstein, Lipman, Hernandez, & de los Reyes, 1997). Furthermore, teachers must also realize the limitations of teaching for social justice. No problem context is guaranteed to engage students of different ethnic, racial, and socioeconomic groups to the same degree (Ogbu, 2003). Furthermore, what happens when students attempt to use social justice to change the status quo and things remain the same? It is important for teachers to help students understand that there are competing voices in a democratic society. What one group considers just and fair may not be interpreted the same way by another group. Even when laws are changed as a result of litigation (e.g., *Brown v. Board*), society may still be slow to change. These issues attest to the fluidity and complexity of sociocultural and sociopolitical influences on teaching and learning.

To conclude, learning rigorous content and developing a strong mathematics identity are critical to achieving mathematics success. Teaching mathematics using CRP and SJP can motivate students from diverse backgrounds to use mathematics as a tool to accomplish their own ends, such as using mathematics in emancipatory ways that lead to social, political, and/or economic empowerment (Freire, 2006). CRP and SJP can potentially lead to the development of a strong mathematics identity that may encourage students to believe they have the ability to learn mathematics, understand the significance of mathematical knowledge, recognize the opportunities and the barriers presented by understanding mathematical knowledge, and develop the motivation and persistence to obtain mathematical knowledge (Martin, 2009). Research on the use of CRP and SJP to improve students' outcomes in mathematics is ongoing. Additional research is needed to provide powerful examples that support moving CRP and SJP from the fringes to the center of mathematics education.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Financial Disclosure/Funding

The authors disclosed receipt of the following financial support for the research and/or authorship of this article: This work was supported in part by Temple University and the National Science Foundation (DRL 0209641).

References

Albert, L. R. (2000). Lessons learned from the "five men crew." In M. E. Strutchens, M. L Johnson, & W. F. Tate (Eds.), *Changing the faces of mathematics: Perspectives on African Americans* (pp. 81-88). Reston, VA: National Council of Teachers of Mathematics.

Apple, M. W. (2003). Freire and the politics of race in education. *International Journal of Leadership in Education, 6*(2), 107-118.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Banks, J. A. (1993). Multicultural education: Development, dimensions and challenges. *Phi Delta Kappan, 75*(1), 22-28.

Blanchett, W. (2006). Disproportionate representation of African American students in special education: Acknowledging the role of White privilege and racism. *Educational Researcher, 35*(6), 24-28.

Brantlinger, A. (2005). The geometry of inequality. In E. Gutstein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers* (pp. 97-100). Milwaukee, WI: Rethinking Schools.

Conant, F. R., Rosebery, A., Warren, B., & Hudicourt-Barnes, J. (2001). The sound of drums. In E. McIntyre, A. Rosebery, & N. Gonzalez (Eds.), *Classroom diversity: Connecting curriculum to students' lives* (pp. 51-59). Portsmouth, NH: Heinemann.

de Freitas, E. (2008). Troubling teacher identity: Preparing mathematics teachers to teach for diversity. *Teaching Education, 19*(1), 43-55.

Dutro, E., Kazemi, E., Balf, R., & Lin, Y. (2008). "What are you and where are you from?" Race, identity, and the vicissitudes of cultural relevance. *Urban Education, 43*(3), 269-300.

Frankenstein, M. (1983). Critical mathematics education: An application of Paulo Freire's epistemology. *Journal of Education, 165*(4), 315-339.

Frankenstein, M. (1995). Equity in mathematics education: Class in the world outside the class. In W. G. Secada, E. Fennema, & L. B. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 165-190). Cambridge, UK: Cambridge University Press.

Freire, P. (2006). *Pedagogy of the oppressed* (30th anniv. ed.). New York: Continuum.

Gonzalez, L. (2009). Teaching mathematics for social justice: Reflections on a community of practice for urban high school mathematics teachers. *Journal of Urban Mathematics Education, 2*(1), 22-51. Retrieved from http://education .gsu.edu/JUME

Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education, 34*(1), 37-73.

Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward pedagogy for social justice*. New York: Routledge.

Gutstein, E., Lipman, P., Hernandez, P., & de los Reyes, R. (1997). Culturally relevant mathematics teaching in a Mexican American context. *Journal for Research in Mathematics Education, 28*(6), 709-737.

Gutstein, E., & Peterson, B. (Eds.). (2005). *Rethinking mathematics: Teaching social justice by the numbers.* Milwaukee, WI: Rethinking Schools.

Haberman, M. (1991). Pedagogy of poverty versus good teaching. *Phi Delta Kappan, 73*(4), 290-294.

Hill, M. L. (2006). Negotiating multiple roles and identities in the field and behind the desk. *Qualitative Inquiry, 12*(5), 926-949.

Hopkinson, D. (1993). *Sweet Clara and the freedom quilt.* New York: Random House.

Ladson-Billings, G. (1994). *The dreamkeepers: Successful teachers of African American children.* San Francisco: Jossey-Bass.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(8), 465-491.

Ladson-Billings, G. (1998). Just what is critical race theory and what's it doing in a *nice* field like education? *Qualitative Studies in Education, 11*(1), 7-24.

Ladson-Billings, G. (2000). Fighting for our lives: Preparing teachers to teach African American students. *Journal of Teacher Education, 51*(3), 206-214.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, UK: Cambridge University Press.

Leonard, J. (2008). *Culturally specific pedagogy in the mathematics classroom: Strategies for teachers and students.* New York: Routledge.

Leonard, J. (2009). "Still not saved:" The power of mathematics to liberate the oppressed. In D. B. Martin (Ed.), *Mathematics teaching, learning, and liberation in the lives of Black children* (pp. 304-330). New York: Routledge.

Leonard, J., Davis, J. E., & Sidler, J. L. (2005). Cultural relevance and computer-assisted instruction. *Journal of Research on Technology in Education, 37*(3), 259-280.

Leonard, J., & Evans, B. (2008). Math Links: Building learning communities in urban settings. *Journal of Urban Mathematics Education, 1*(1), 60-83. Retrieved from http://education.gsu.edu/JUME

Leonard, J., Napp, C., & Adeleke, S. (2009). The complexities of culturally relevant pedagogy: A case study of two secondary mathematics teachers and their ESOL students. *High School Journal, 93*(1), 3-22.

Lipka, J., Hogan, M. P., Webster, J. P., Yanez, E., Adams, B., Clark, S., et al. (2005). Math in a cultural context: Two case studies of a successful culturally based math project. *Anthropology in Education Quarterly, 36*(4), 367-385.

Martin, D. B. (2000). *Mathematics success and failure among African American youth: The roles of sociohistorical context, community forces, school influence, and individual agency.* Mahwah, NJ: Lawrence Erlbaum.

Martin, D. B. (2007). Beyond missionaries or cannibals: Who should teach mathematics to African American children? *High School Journal, 91*(1), 6-28.

Martin, D. B. (2009). Liberating the production of knowledge about African American children and mathematics. In D. B. Martin (Ed.), *Mathematics teaching, learning, and liberation in the lives of Black children* (pp. 3-38). New York: Routledge.

Morris, J. E., & Monroe, C. R. (2009). Why study the U.S. South? The nexus of race and place in investigating Black student achievement. *Educational Researcher, 38*(1), 21-36.

Moschkovich, J. (2002). A situated and sociocultural perspective on bilingual language learners. *Mathematical Thinking and Learning, 4*(2-3), 189-212.

Moses, R. P., & Cobb, C. E., Jr. (2001). *Radical equations: Math literacy and civil rights.* Boston: Beacon.

Nasir, N. S. (2002). Identity, goals and learning: Mathematics in cultural practice. *Mathematical Thinking and Learning*, *4*(2-3), 211-245.

Nasir, N. (2005). Individual cognitive structuring and the sociocultural context: Strategy shifts in the game of dominoes. *Journal of Learning Sciences, 14*(1), 5-34.

Nasir, N. S., Hand, V., & Taylor, E. V. (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 Council of Teachers of Mathematics. (2000). *Principles and standards of school mathematics.* Reston, VA: Author.

Nieto, S. (2002). *Language, culture, and teaching: Critical perspectives for a new century*. Mahwah, NJ: Lawrence Erlbaum.

Ogbu, J. U. (2003). *Black American students in an affluent suburb: A study of academic disengagement*. Mahwah, NJ: Lawrence Erlbaum.

Preece, J., & Griffin, C. (2006). Radical and feminist pedagogies. In P. Jarvis (Ed.), *The theory and practice of teaching* (2nd ed., pp. 53-70). New York: Routledge.

Rappaport, D. (2000). *Freedom river.* New York: Hyperion.

Ringgold, F. (1992). *Aunt Harriet's Underground Railroad in the sky.* New York: Crown.

Sleeter, C. E. (1997). Mathematics, multicultural education and professional development. *Journal for Research in Mathematics Education, 28*(6), 680-696,

Spurlock, M. (Director). (2004). *Super size me* [Motion picture]. Los Angeles: Samuel Golden Films.

Staples, M. (2005). Integrals and equity: A math lesson prompts new awareness for prep school students—and their teacher. In E. Gutstein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers* (pp. 103-106). Milwaukee, WI: Rethinking Schools.

Stiff, L., & Harvey, W. B. (1988). On the education of Black children in mathematics. *Journal of Black Studies, 19*(2), 190-203.

Tate, W. F. (1995). Returning to the root: A culturally relevant approach to mathematics pedagogy. *Theory Into Practice, 34*(3), 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. 31-20). Milwaukee, WI: Rethinking Schools.

Tillman, L. C. (2002). Culturally sensitive research approaches: An African-American perspective. *Educational Researcher, 31*(9), 3-12.

Turner, E. E., & Strawhun, B. T. F. (2005). "With math, it's like you have more defense": Students investigate overcrowding at their school. In E. Gutstein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers* (pp. 81-87). Milwaukee, WI: Rethinking Schools.

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