
Changing the Game while Playing the Game: Teaching Social Justice Mathematics

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In this paper, I will share my goals as a social justice mathematics teacher, which include to deconstruct mathematics, to connect mathematics to students' lives, to honor multiple approaches to thinking mathematically, and to encourage student leadership of the learning in the classroom. I will describe and reflect on a social justice unit I designed and taught, which explores whether police traffic stop data is proportionate to racial demographic data. By critiquing my social justice unit, I will offer ideas for improving students' understanding of proportionality and for empowering students to see themselves as agents of change. Finally, I will argue that a social justice mathematics curriculum gives students from traditionally marginalized communities greater access to mathematical literacy, while developing their social consciousness and agency.

Introduction

Changing the game of mathematics means partly rewriting the narrative about who contributes to mathematics and who does well in it. It also means offering new ways of envisioning school mathematics by considering home communities and other ways of viewing the world. Changing the game of mathematics also means students are able to use mathematics to acknowledge hegemony in society and can address social and political issues of importance in their communities. (Gutiérrez, 2009, p. 11)

The mathematics achievement gap between White, middle-class students and students in marginalized communities (including students of color, working class students, and English language learners) has been

well documented by U.S. education researchers. As a result, the focus on the achievement gap has emphasized the failure of marginalized students in mathematics and normalized the achievement of White students as the standard for all students (Martin, 2012). Standardized tests measure achievement in school mathematics and not the mathematical thinking and learning done in marginalized communities. In fact, Tate (1994) argues that a barrier to African-American students' learning and success in mathematics is that the curriculum does not reflect their ways of thinking mathematically and their own cultural and community experiences. A mathematics curriculum must address the diverse racial, cultural, socio-economic, gender, and sexual orientation identities of students. A social justice mathematics curriculum allows students to explore and analyze important social, political, and economic inequities in their communities (Ukpokodu, 2011). Students from marginalized communities are empowered because their identities and experiences are reflected in a social justice curriculum and because they are given the opportunity to counter the prevailing narrative about their lack of achievement in mathematics. Thus, one way to change the game of mathematics education, as Gutiérrez (2009) suggests, is for mathematics educators to embrace the teaching of mathematics through a social justice curriculum.

The purpose of this paper is to describe my goals and learning process in designing and implementing a social justice mathematics unit. By using mathematics as a lens for analyzing an injustice in their community, I hoped that students would engage deeply with the mathematics content while being encouraged to see themselves as successful in mathematics and as leaders in their school and communities. My specific goals for the social justice unit are described in detail later on in this paper. It is important to note that creating a social justice curriculum is not easy and can feel risky. In this paper, I will honestly reflect on these difficulties and critique my social justice unit based on the goals I set for myself. In fact, I will offer changes to the unit so that it better meets my goals. At the time of the conference, I will have taught the unit, with the changes described in this paper, at least twice more and will be able to provide further feedback on it. Additionally, I plan to invite several students to present with me. Above all, my commitment to the success of all students and, in particular, my belief that students in marginalized communities can learn mathematics as well as any other students are what drive me to

advocate for the teaching of mathematics using social justice.

Context

I work at an alternative school in Portland, Oregon called Portland YouthBuilders (PYB). It is a vocational school, where students gain valuable skills in construction or in technology and media while achieving high school completion. All students that enter PYB are low-income, between the ages of 17 and 24, and on average have been out of school for two years. Students enter PYB with the burden of many labels that barely scratch the surface of who they really are, including “high school drop out,” and “at-risk youth.” I have learned the importance of getting to know them beyond these labels and of continually working to build strong relationships with them. As their teacher, I focus on the learning not the labels (Aguirre, Mayfield-Ingram, & Martin, 2013). PYB students have shown an incredible resilience in their outside lives and astonishing courage to decide to return to school despite the negative educational experiences they have had in the past. I work with students to rewrite the single story of their underachievement and failure in mathematics and school by emphasizing their success and resilience (Martin, 2012).

Goals for Social Justice Mathematics Teaching

In order to connect with my students, to engage them in thinking deeply about mathematics, and to empower them to be leaders in their communities, I have created several goals that I strive to achieve when I teach. It is through a social justice mathematics unit that I am best able to meet these goals. The following sections explain my goals and how a social justice framework helps me to achieve them.

To Deconstruct Mathematics

Traditionally mathematics is seen as culturally-neutral and objective (Tate, 1994). On the contrary, mathematics knowledge is culturally-situated and it is not a universal truth. For example, mathematics problems

involving roller coasters, skiing, down payments, and/or pumpkin pie may prevent students from showing their mathematical knowledge or disengage them because the context is not culturally relevant nor part of their lived experience. Ethnomathematics studies how different cultures have different ways of thinking, learning, and doing mathematics (D'Ambrosio, 1997). Moreover, students from different cultural backgrounds may have different ways to approach, think, reason, and process mathematically. It is important that teachers understand this and dispel the misconception that there is only one way to do mathematics (Ukpokodu, 2011). I make sure to explicitly deconstruct the universality of mathematics with students and we discuss how it is culturally-influenced. Using a social justice curriculum allows students to view mathematics in a new way: as a useful tool for exploring and analyzing injustices in their communities and in the world.

To Connect Mathematics to Students' Lives

By connecting mathematics to students' lives, students see the relevancy of what they are learning, they are more engaged, and they are more likely to identify with being a thinker and doer of mathematics. Aguirre et al. (2013) identifies drawing on multiple resources of knowledge, including students' cultures and communities, as one of the five equity-based practices in the mathematics classroom. These practices serve to improve learning and encourage students to develop positive mathematical identities. When students explore a social justice issue that affects their community, they become an important source of information as do other members of their community. Thus, when mathematics is presented in a familiar context, students from marginalized communities are empowered to counter the prevailing deficit narrative because they contribute knowledge in the mathematics classroom.

To Explore Multiple Ways of Learning Mathematics

Martin (2012) argues that in order to understand how Black children reason and think mathematically in school, researchers must explore "the variety of ways these children engage in mathematical thinking and knowledge construction in relation to the demands of their

everyday lives” (p. 57). Students may successfully use mathematical thinking strategies in their everyday lives, but not in the classroom because the strategies they use outside of school are unlike those that are shown in class by the teacher. A culturally responsive teacher rejects the notion that there is only one, right way to solve a mathematics problem and is open to students’ divergent thinking and problem-solving styles (Ukpokodu, 2011). Hence, I often ask students: Did anyone solve this in a different way? In my classroom, students are encouraged to share their own strategies and we challenge ourselves as a class to represent as many ways to solve a problem as possible. When students’ lives and communities are already brought into the classroom in a social justice curriculum, students are more likely to believe that the mathematical strategies they use outside of classroom will also be accepted.

To Allow Students to Take the Lead

An important aspect of teaching is empowering students to “see themselves as legitimate and powerful doers of mathematics” (Aguirre et al., 2013, p. 14). I model openness to multiple problem-solving strategies by asking students to present their reasoning and thinking to each other. Students have agency and choice to use the strategy that works best for them. In my classroom, students are often in the front of the room, teaching us about their solution strategy or mathematical thinking process. In fact, my students have taught me many of the unique and successful strategies for thinking about mathematics that I currently share with students. When defining critical pedagogy, Paulo Freire (1970) speaks to the joint responsibility of both students and teacher to be both learners and teachers. “The teacher is no longer merely the one-who-teaches, but one who is himself taught in dialogue with the students, who in turn while being taught also teach” (p. 80). This shared responsibility for teaching and learning is especially important in a social justice oriented curriculum since multiple perspectives are required for a deep analysis of the injustice. A social justice mathematics unit builds collective mathematical agency (Aguirre et al., 2013) because both students and teacher work together to solve mathematical problems and explore inequities. In addition, students may be inspired to be agents of change by taking action against these injustices in their communities.

To Reflect on My Own Assumptions

Teaching is about inspiring students and about student learning, but it is just as much about a teacher's personal and professional empowerment and growth. "Professors who embrace the challenge of self-actualization will be better able to create pedagogical practices that engage students, providing them with ways of knowing that enhance their capacity to live fully and deeply" (hooks, 1994, p. 22). The more I strive to fulfil my own potential, the better prepared I am to open-mindedly address the wide array of student needs and interests. I engage in deep personal reflection on my practice as a mathematics teacher and seek to uncover my own weaknesses, assumptions, and biases. In particular, as a White teacher, I challenge myself to deconstruct the White, middle class values that I have normalized in order to continually de-center whiteness. I reflect on how students walk in the world differently and similarly to myself because of their racial, cultural, socio-economic, sexual orientation, and gender identities. For teachers to support the creation of positive mathematical identities in their students, teachers need a deep understanding of the multiple identities and social realities of their students (Aguirre et al., 2013). By exploring a social justice issue in students' communities, I am able to gain better insight into my students' lives because their experiences become important sources of information to the project. As a result, students' identities are validated and recognized in the classroom.

Social Justice Mathematics Unit on Traffic Stop Data

I chose to deepen students' knowledge of fractions, percentages, and proportionality through a social justice unit that analyzed traffic stop data. The Portland Police Bureau had recently released a report to respond to concerns from community stakeholders about racial disparities in the stop and search data and potential racial profiling (Stewart & Covelli, 2014). Additionally, I had heard from multiple students, and in particular students of color, about times that they were pulled over without reason by police officers while walking or driving. Hence, traffic stop data was not only directly relevant to many of my students'

lives, but also an important issue to students as citizens of the city of Portland. This unit was an opportunity for students to work together to see how mathematics could be used as a tool for exploring issues that affect them. Ultimately, my hope was that students would be empowered to get involved in advocating for changes to the Portland Police Bureau's stop and search policies. Paolo Freire (1970) asserts, "Students, as they are increasingly posed with problems relating to themselves in the world and with the world, will feel increasingly challenged and obliged to respond to that challenge" (p. 81). Although my intention was to encourage student leadership and involvement, I will describe how my first attempt at this social justice unit did not let students take the lead nor feel a sense of agency. I will offer changes to my social justice unit that allow students more choice in how to explore the data and to affect change in their communities around police stops and searches. No doubt I will have further reflections and critiques at the conference of what I can continue to improve.

At the start of the unit, I asked students to write about a time when they were unfairly accused of something. Additionally, I asked students to respond to the following questions: Were the police or a security officer involved? How did this make you think or feel? Did you do anything to prove it was unfair? Why or why not? Then, I had students share these stories with each other. Starting with students' experiences helped them to see the connection between the unit and their everyday lives. It also sent the message to students that their experiences were valuable data. Next, in small groups, students looked at the racial breakdown of traffic stop data in Table 1 from the Portland Police Bureau's report (Stewart & Covelli, 2014). I left out the percentages and had students calculate them. I also asked students to use estimation to create fractions with the number of people of each race pulled over as the numerator and the total number of stops as the denominator. Then, students had to write a sentence using either the percentage or the fraction to represent approximately how many people of each racial demographic in the table got pulled over. For example, about one out of every 20 people pulled over was identified as Asian. We talked about how it was important to use the phrase "was identified as" because Portland police officers entered the race in the computer system, so it might not represent how the person pulled over actually identifies. Letting students react to the race categories used by the Portland Police Bureau was important in validating

students' racial identities. For example, my student who proudly identifies as Pacific Islander wondered how he would have been identified by police officers and students who identified with multiple races felt that these racial demographic categories were highly limited.

As the next step, I gave students a challenge: To write down as many facts, comparisons, surprises, and thoughts that they had as they looked at the data. Afterwards, each group shared with the rest of the class. It was important that we had a multitude of perspectives and thoughts about the data. While each group presented, I asked students to think about the question: Are the Portland Police pulling people over fairly? When I led students in a conversation about fairness, I directed students toward the need to compare the traffic stop data to the racial demographics of the city of Portland. However, students had other ideas about how to measure fairness, for example to look at the racial demographics of who drives in Portland or to look at how many traffic stops lead to tickets, arrests, or seizures of drugs and/or guns. Some of this data is even included in the Portland Police Bureau report and would be easy for students to explore. Nevertheless, I was so tied to my plan for the next day to explore the racial breakdown of the Portland population, I did not allow students to think mathematically about fairness from multiple approaches. Later I will address how changes to this social justice unit will allow students to explore alternate perspectives of fairness in the traffic stop data.

Students engaged with U.S. Census Bureau data from 2010 on the racial demographics in Portland in much the same way as the traffic stop data. Students calculated percentages based on the total population in Portland and the number of people identifying as each race. It is important to emphasize for students that the race and ethnicity categories are defined differently on the Census than in the Portland Police report. For example, the U.S. Census Bureau (2014) defines Hispanic/Latino as an ethnicity and not a race and in addition people can identify as two or more races. I asked students to write a short paragraph about their reaction to the demographic data using specific percentages and fractions to support their claims. Several students were surprised that the percentage of people identifying as White was over 75% in Portland (U.S. Census Bureau, 2014). This observation led to a conversation about how different neighborhoods in Portland would reflect different racial demographics. Although students were curious to explore the racial demographics of their own and other

neighborhoods in Portland, they were not given the chance to satisfy that curiosity in this social justice unit.

The next day we began a discussion about proportionality and how to decide whether the traffic stop data was proportional to the racial demographic data of Portland (the measure of fairness we used). Upon reflection, I believe I led students to the definition of proportionality and handed them the process of comparing the percentages without a deep conceptual understanding of proportionality nor why it could serve as an indicator of fairness. To wrap up the exploration of traffic stop data, I had students define racial profiling and I asked students to write a paragraph about whether they thought the traffic stop data showed that racial profiling was a problem in the Portland Police Bureau. Students were allowed to use both the data and their personal experiences. Since my students' voices often go unheard, I wanted to give students the opportunity to share from their own experiences and include that in their explanations as valuable data. I also asked students to come up with one or two aspects of this data that they would like to study further. Several students mentioned they wanted to look at where the majority of the traffic stops were occurring because they suspected that traffic stops were concentrated in specific neighborhoods in Portland. Other students wanted to explore how socio-economic status plays a role by looking at the condition of the cars being pulled over. They hypothesized that more traffic stops involved cars that were old and looked beat up. However, due to time constraints, after students shared their conclusions about racial profiling and ideas for further study in a large group discussion, I brought the social justice unit to a close.

Although I felt proud to have tried a social justice lesson with students, I was disappointed that the unit did not create a student-led learning environment where students could explore the traffic stop data driven by their own curiosity. Students did not see themselves as agents of change because they were not asked to think about ways to engage with this issue in their communities, nor were they provided with examples of ways that members of their community are involved in this issue. One of my African-American students struggled to come up with ideas for what he would have liked to explore further. When I checked in with him individually, he sighed heavily and said, "This is hard. It's about me. What can I do?" I had underestimated the emotional impact that looking at this data might have

on my students of color, particularly the African-American men. As a White woman, I could look at this traffic stop data, which shows that a disproportionate number of African-Americans get pulled over, and think about racial profiling from a very intellectual place. In contrast, for my African-American students, these statistics represented very real and painful everyday experiences. More importantly, my student had expressed hopelessness in changing these statistics. Clearly, I had not achieved my goal of letting students take the lead and did not empower students to affect change in their communities.

Another critique was that the unit defined proportionality for students, instead of allowing them to develop their own understanding of proportionality. According to Eric Gutstein (2003), who also developed a project with his students to analyze racially disaggregated data on traffic stops, the mathematical concept of proportionality is key in understanding racial profiling. In order to build students' conceptual understanding of proportionality, Gutstein (2013) gave groups of students a small bag with colored cubes to represent the racial breakdown in the city. Students took a cube from the bag without looking, recorded its color, and replaced the cube 100 times. After every 10 picks, students recorded the total cumulative picks for each race/ethnicity and calculated the fraction and percentage of each. Next, students created their own simulation based on data about the number of Latino motorists and compared their simulation to the actual percentage of Latino drivers pulled over.

Next time I give my social justice unit on traffic stop data, I will have students explore the racial breakdown of Portland using the colored cubes. Then, I will give students the racially disaggregated data on motorists in Portland and ask them to create their own simulation using cubes (Stewart & Covelli, 2014, Table 3). Although I will give students clear directions, I will keep it open-ended so that groups of students can choose to focus on data from one or more races/ethnicities depending on their interests and identities. Students will use the percentages from their simulations to compare to the percentages of each race/ethnicity pulled over at traffic stops in Portland. There are several advantages to these changes. First, students are developing a stronger understanding not only of proportionality, but also experimental and theoretical probability. Second, groups of students are allowed to create their own simulation, instead of being told how to show proportionality, which gives students more ownership of their

learning. Third, by drawing cubes out of the bag, students are engaged in a different approach for thinking about percentages and fractions.

Finally, I will not be satisfied that I have achieved my goals with this social justice unit unless it helps students develop a “belief in themselves as conscious actors in the world” (Gutstein, 2003, p. 40). For students to develop a sense of agency, they must see that they can play a part in interrupting injustices in their communities. Students can research what is already being done to counteract the inequities they studied and get involved or start their own projects. In the case of my social justice unit, I will have small groups of students explore one other social justice issue represented in the Portland Police Bureau Report on traffic stop data that interests them. Students will use mathematics to create a visual model or simulation to expose the inequity in the data. They will research what is currently being done to respond to either the injustice they explored or the issue of racial disparities of who gets pulled over in Portland. In doing so, students will generate a list of possible solutions and ways to get involved. As a whole group, we will decide our next step in supporting the end of racial profiling. For example, students could decide to bring in a police officer to answer students’ questions or to write a letter to Portland’s Independent Police Review, a division responsible for the civilian oversight of the Portland Police Bureau. Lastly, I will ask students to reflect on how mathematics helped them in the social justice unit. In doing so, I will explicitly ask students to deconstruct mathematics and to show how it can play a powerful role in revealing injustice and in helping to stop it.

Conclusion

To provide schooling for everyone’s children that reflects liberal, middle-class values and aspirations is to ensure the maintenance of the status quo, to ensure that power, the culture of power, remains in the hands of those who already have it. (Delpit, 1995, p. 28)

When students do not see themselves or their own life experiences reflected in the curriculum, it devalues their home cultures and disengages students from the learning. Students of color and poor students are made to feel that they must change themselves to meet

White, middle class standards. Bright and motivated students from marginalized communities are denied access to what Delpit (1995) calls the culture of power, or the set of tools, language, behaviors, and knowledge of the dominant culture, which are required for upward mobility and full participation in the U.S. democracy. Robert Moses, the creator of the Algebra Project, a national math literacy program serving a predominately African-American community, would agree. He believes mathematics literacy is a civil right and inexorably linked to “the on-going struggle for citizenship and equality for minority people” (Moses & Cobb, 2001, p.14). In effect, marginalized communities are being disenfranchised from the political process when they don’t achieve mathematical literacy.

However, in order to achieve equity in mathematics education, teachers need to prepare students not only to play the game of mathematics education, but also to change the game of mathematics education (Gutiérrez, 2009). A social justice mathematics curriculum changes mathematics education by deconstructing traditionally held views of mathematics, connecting mathematics to the lives of marginalized students, presenting multiple approaches to thinking and learning mathematics, and by allowing students to develop leadership and agency within the curriculum and in their own lives. Gutstein (2003) defines mathematical power as developing an understanding of the complexities of the systems of power and privilege while seeing mathematics as a tool for uncovering and resolving these injustices in the world. In other words, a social justice mathematics curriculum gives students in marginalized communities greater access to mathematical literacy (as part of the culture of power) and mathematical power and agency.

I have set as a goal to reflect on the assumptions I bring to my teaching practice, in particular how my identity as a White, middle-class, heterosexual woman impacts the teaching and learning of my students. While constant reflection is important, so is the transformation from teacher to teacher-activist. Mathematics is not a politically neutral activity (Gutiérrez, 2009). By teaching a social justice curriculum, I am taking a political stance in shifting the way mathematics is taught in my classroom, acknowledging hegemony, and addressing social and political issues of inequity in my classroom. As Delpit (1995) suggests, I strive to be “unafraid to ask questions about discrimination, and voicelessness of people of color, and to

listen, no hear, what they say” (p. 47). Developing students as agents of change means that teachers must model activism in their daily lives. By becoming involved in organizations seeking to end social and political injustices, teachers can more easily connect and involve students in organizations making change in their communities. Thus, students are empowered themselves to be leaders and activists in their schools and communities. As a social justice mathematics teacher, I will continue to challenge myself to create stronger social justice lessons, but more importantly I am committed to becoming a stronger advocate for my students and activist in my school and community.

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