Abstract
This article is about developing and teaching students to read and write the world with mathematics (RWWM) in an urban Chicago (USA) high school. RWWM is a form of critical pedagogy using mathematics. The essence of RWWM is that young people use and learn mathematics to study their social reality—in this way, they more deeply understand their world as a way to prepare them to become actors in history. RWWM builds on the work of Paulo Freire and education for humanization and liberation. It also builds on the work of critical (mathematics) educators across the world who have attempted to “reinvent” Freire in their own contexts. In this paper, I briefly report on my critical mathematics classroom where I developed and taught curriculum based on the generative themes of students’ lives (key social contradictions as students define and articulate them). I give a short example of students using mathematics to understand displacement in their community, and point out some possibilities and challenges of doing this work.

Introduction
My twelfth-grade mathematics class was winding down. Students silently and soberly stared at the numbers I was writing on the board:

\[ 150,000 - 291,000 = 92,000 \]

This “equation” modeled a mortgage loan for a house in the students’ neighborhood. As I wrote on the board, I told students: “You’ve paid two hundred and ninety-one thousand dollars on a one hundred and fifty thousand dollar mortgage, and you still owe ninety-two thousand dollars. Check that math out. One hundred and fifty thousand minus two hundred and ninety-one thousand equals ninety-two thousand.” I paused as students looked and mumbled to themselves and each other. I continued, “Think about that. Hey!
You started with a hundred and fifty—you paid two ninety-one—and you still owe ninety-two thousand dollars. What’s going on here?”

[my students responded]
Antoine: “They’re taking your money.”
Daphne: “The bank is taking advantage of you.”
Mr. Rico [my classroom name]: “This is legal—this is how banks loan money and make money.” Silence. I paused and repeated slowly. “This is legal— this is how banks loan money and make money.” I paused again.
As class ended, I asked, “What are some questions you could ask here?” Renee said, “Why is it legal?” and Daphne asked, “Why don’t more people look into it so they don’t end up in the same situation?”

So went a more-or-less typical day in my class. I taught with the goal that students learned to read and write the world using mathematics (RWWM; Gutstein, 2006, 2016). That is, my aim was for students to develop a deep understanding of mathematics through using it to study their social reality (or “reading the world”), and, while doing this, to create and extend their own analyses of contradictions in society and their lives. The overall purpose is to prepare students to change reality as they see fit (i.e., “writing the world”).

This work represents my attempt to reinvent Paulo Freire. As he put it, “in order to follow me, it is essential not to follow me!” (Freire & Fauandez, 1989, p. 30). Freire’s goals were essentially that education needs to be part of the overall struggle for full humanization and liberation of all peoples (Freire, 1970/1998). He argued that while education could not make the world change, the world would not change without education. That gives education its essential meaning in the process of humans shaping reality. He also believed firmly that we are unfinished, all of us (Freire, 1998). For him that was a source of joy, because we are not destined to be something not of our making. Freire saw history as possibility, that human beings, conscious of our world, both shape social life while also being influenced by it. In this sense, he considered people as both subject and object of history. He railed against neoliberal ideology which proclaimed that “there is no alternative.” Freire’s hope came through his notion of human unfinishedness,
and also from his understanding of the dialectical relationship of hope and struggle. He wrote that without hope, you really cannot begin the struggle, and you certainly won’t be able to maintain it. But without the struggle, hope stays as a dream, never materializing. You have to fight to make your hope a reality. He wrote that the two need each other like fish need clean water (1994).

Freire worked in contexts in the global South, particularly in Latin America (Brazil, Chile) and in some post-colonial African nations (those colonized by the Portuguese). Teachers, researchers, workers, peasants, cooperative members, activists, and revolutionaries have tried to reinvent Freire in other spaces around the world, including in urban US schools, in communities of color (here I use common US terminology to signify African American, Latino/a, Asian/Pacific Islander, and Native communities). For years, some US teachers have used Freire’s ideas of supporting critical consciousness linked to academic study. It is not widespread in US schools, but it definitely exists, and these efforts are across K-20 settings. Furthermore, there is a whole tradition and history of education for liberation that grow out of resistance to slavery and education for “stupidification” (as Macedo, 1994, called it). These liberatory education struggles are part of the Black freedom struggle in the US and provide insight and inspiration to others as well (Anderson, 1988; hooks, 1994).

Mathematics education, surprisingly, has been a site of much critical pedagogy work. Critical mathematics exists in multiple countries, and while it has many definitions, it is always linked to learning mathematics and working for a better world (Chronaki, 2017; Skovsmose, 1994; Wager & Stinson, 2012). It often challenges the high status of mathematical knowledge, its relation to the economy, its racialized aspects, its exclusionary functions, and many other ideas. In this paper, I give an overview of one instance of critical mathematics, the one with which I started this paper—my 12th grade mathematics class in a Chicago public school. I start with a little background, describe the class, and briefly describe some things we learned and some open questions.

I am a US-born-and-raised mathematics teacher educator at a public university in Chicago. As part of my work as a professor, I have worked with and taught in Chicago public schools for 25 years. I am also part of the education justice movement in Chicago, which primarily has fought to transform public education and against the privatization of
education and displacement of economically disadvantaged people of color from the city. As a mathematics educator, I taught my own mathematics classes for about 5 years in Chicago public schools (in middle and high school). In these classes, I learned how to teach critical mathematics. I studied my own practice, worked with students as coresearchers into what we were learning, and wrote and taught about critical mathematics. I have co-presented with students at academic and teacher-activists conferences perhaps two dozen times through the years. All of these have been learning experiences.

The class with which I start this paper was in a school that focused on social justice—in fact, its name is the Social Justice High School (Sojo for short). Sojo is in a working-class Chicago community called Lawndale. Because Chicago is so racially segregated, there are two parts of Lawndale. South Lawndale (or La Villita) is primarily Mexican immigrant families, while North Lawndale is overwhelmingly African American. A railroad bridge separates the two parts of the neighborhood. Sojo is located in South Lawndale and 70% of students were from that community, with about 30% of the students being African American from North Lawndale. All students were from working-class, low-income families. I was part of the team that founded the school in 2005. I worked closely with students and teachers through the first five years of school. In 2008-09, I taught my own “mathematics for social justice” class, of 21 students from the neighborhood, after having done similar work in a middle-school in a nearby neighborhood (Gutstein, 2006).

Following Freire, I tried to uncover the generative themes of students’ community. Freire referred to these themes as the dialectical connections between key social contradictions in people’s lives and how people understood and acted on them. For Freire, themes are neither in the world, nor in people, but rather, they are in the human-world interaction (Freire, 1970/1998). Understanding the people’s generative themes is an essential and initial component to enacting a Freirean critical pedagogy in schools, although teachers deepen their own knowledge about the community’s themes as they teach and learn with young people and adults from the neighborhood.

Although I was familiar with the school’s students and community, it is not my place to attempt to name their generative themes. Therefore, I met twice with students before the year I taught them in order to discuss what we would study. Collectively, we agreed upon five units, one of which was on displacement. This was at the start of the 2008-9
global economic crisis, and many people in the US were not able to continue paying their home mortgages. Banks were repossessing people’s homes (through foreclosures), and across the US, people were fighting to keep their houses and stay in their communities. This was especially true in both North and South Lawndale, where foreclosures had tripled since 2005.

The displacement unit was long—13 weeks, which was one-third of our school year. The unit’s central question was: Whose Community Is This—Can We Stay In Our Own Community? There were three main forms of displacement at work in Lawndale, but they did not affect North and South Lawndale identically. Foreclosures hit both parts of Lawndale relatively equally. However, the second form of displacement, gentrification (pushing out less-wealthy residents as house prices and rents increase and more well-off people move in), affected only North Lawndale because it was slightly closer to downtown Chicago, located on a highway and two train lines, and had better housing stock than South Lawndale. Real estate developers were just beginning to build higher cost housing (condominiums) in North Lawndale as more economically disadvantaged people were pushed out. And the third form of displacement was deportation, which affected only South Lawndale and not North Lawndale’s Black community because within South Lawndale are many thousands of Mexican immigrants who lack official US documents to be in the country. They live in constant fear of being caught and sent back to Mexico. The complexity of how displacement impacted the two parts of Lawndale in similar and different ways was central to the unit.

Students developed essential understandings of these phenomena through using mathematics. They developed the mathematical equations to model a mortgage. Through this process, they saw that a Lawndale family making the median income could not afford a mortgage of $150,000, at the current interest rates. Students realized that one could borrow $150,000 and over a 30 year period, pay almost twice that amount, while still owing the bank almost $100,000. This was a lesson in capitalist economics. I told students explicitly that day, “Understand how banking works—how capitalism works”—but they did the mathematics to more fully grasp the phenomena.

An important part of a critical pedagogy is that learners are given the opportunity to "know better what they already know", as Freire put it, and develop a more complicated
comprehension of things that they experience. That is, all my students knew that banks were foreclosing homes in Lawndale. They knew this because their own families were losing homes, or struggling hard to save them. They knew this because it was impossible to walk to school without passing many boarded-up homes, victims of bank foreclosures. Basically, every street in the school’s neighborhood had boarded-up homes. Students lived with the ever-present reality of foreclosures, gentrification, and deportation, though they could not initially explain why these things occurred or why these forms of displacement particular impacted communities such as their own.

It was the combined reality of all three forms of displacement in Lawndale that made it a generative theme. Students came to understand foreclosures through using mathematics, as they learned to create and analyze complicated mathematical entities called *discrete dynamical systems* (essentially discrete versions of differential equations). They used these systems to model the mathematics for various forms of mortgages and foreclosures. Students studied deportation by analyzing data, examining immigration trends, and looking at labor section employment. And they developed the mathematics of gentrification in ways similar to analyzing mortgages. As the forms of displacement affected the class, school, and community differently in the two parts of Lawndale, my political goal of the unit was for students to use and learn mathematics to realize the whys and how of their experiences. I wanted them to uncover that despite surface-level distinctions, when one traced the source of the displacement impacting both parts of the community, one would understand that there is the same system of racial capitalism that treats both communities as sources of profit. Mathematics became a way of understanding many of the complexities involved in the plundering of working-class communities of color where my students lived (Gutstein, 2016).

Though students learned both mathematics and about their social reality, there were (and are) many challenges. First, my political goal in the unit could not easily be reached. A long, intense effort is needed to fully unpack how global financial markets work at local levels. Second, US students, especially economically disadvantaged students and students of color, are poorly educated. Their understanding of mathematics is often weak through no fault of their own. Some students perform well on tests and memorization tasks, but cannot use mathematics in the world, let alone analyze social
reality with it. That means that teachers may have to spend extra time supporting students mathematically. Third, pressures of test and performance weigh heavily on both students and teachers. College is very expensive and student debt is enormous (estimates for US students are around $1.5 trillion). Tests are often necessary to gain financial assistance, and usually only the most successful students in school win scholarships. This is very stressful to students. Furthermore, school test scores become part of school districts’ argument for closing schools, which leads to, and is part of, privatization of education and displacement (Lipman, 2011). This impacts all the families and school staff. It means that students must do well on the tests which severely constrains the time, energy, and initiative of teachers who want to teach students to read their world with mathematics.

There are other difficulties, particularly for teachers. While research documents what mathematical and pedagogical knowledge teachers need to teach students to understand mathematics conceptually (e.g., Ball, Thames, & Phelps, 2008), how to develop critical mathematics teachers is not well understood. Critical mathematics demands that teachers teach about both mathematics and social reality, in connected ways. The synthesis is difficult and learning how to orchestrate it takes substantial time. There’s a dialectical relationship between supporting students to learn the mathematics they need for various forms of school success—while simultaneously fostering their critical perspectives on the world. Teacher and students together are involved in a “dance” between mathematics and sociopolitical reality, in a continuum between two connected poles. Sometimes, in my Sojo class, we only did decontextualized mathematics, though not often. Sometimes, we only studied a real-world situation, also infrequently. But mostly, we were somewhere in the space that more or less connected mathematics and sociopolitical reality, emphasizing one or the other, moving back and forth and interrelating the two. The more students grasped the mathematics, the better they realized, overall, what was happening to their community; the better they comprehended their reality using mathematics, the more mathematics made sense as an explanatory and revealing phenomenon.

This back-and-forth space is where one wants to be, where students see the relationships between mathematics and social reality, and each supports the other. The displacement affected my students, who saw foreclosed houses and experienced it
happening to friends, families, and themselves. Together, we posed questions, which were theirs as well as mine: Whose community is this? Who can live here? Who’s making money from the misery of the people? Why is this legal? How can banks do these things? One can begin to answer these questions through mathematics, by analyzing subprime (i.e., high-cost) mortgages, loan interest and principal, predatory lending (i.e., preying on particular vulnerable populations), trend lines in housing prices and foreclosures, and more. The mathematics makes sense to students. They understand why we study it because it helps shed light on real issues of meaning to young people. And they learn the mathematics because they want to change the situation and not just be academically successful. One cannot know whether my students would have learned more—or less—mathematics had they never taken my classes. But I can say that they learned mathematics and about their worlds. They say so too. This is a genuine possibility of critical mathematics.

Conclusion

I have tried to briefly sketch out how one can reinvent Freire in a high school mathematics class in the global North, far from Freire’s culture circles in rural Brazil or Chile, or from other venues in which he worked. My experiences have taught me that there are no shortcuts to learning how to teach critical mathematics. Indeed, it may be that teachers’ involvement in political activity and the life struggles of the communities in which they teach may be the most important source for the political knowledge that teachers need to teach young people to read and write the world with mathematics (Gutstein, 2018). Freire argued that a source of learning for teachers about learners’ generative themes lay in teachers’ participation in social movements. He wrote that

...a radical and critical education has to focus on what is taking place today inside various social movements and labor unions. Feminist movements, peace movements, and other such movements that express resistance generate in their practice a pedagogy of resistance. (Freire & Macedo, 1987, p. 61)

That is, one learns to engage in political struggles and social movements through being part of them. Freire (1970/1998) wrote, in Pedagogy of the Oppressed:
The revolutionary process is dynamic, and it is in this continuing dynamics, in the praxis of the people with the revolutionary leaders, that the people and the leaders will learn both dialogue and the use of power. (This is as obvious as affirming that a person learns to swim in the water, not in a library). (p. 118)

Thus, learning to teach critical mathematics, according to Freire, comes through involvement in social movements that generate in their practice a pedagogy of resistance, and through the actual practice of teaching critical mathematics. As he put it, people needed to “sneak up on the theory that was imbedded in their practice” (Freire, 1994, p. 126). This is ongoing work, and in a US context, part of the radical transformation of society in which many are engaged.

I leave this story with a short writing from one of my Sojo students, which I believe also represents the possibilities. I asked him to write down what he thought reading and writing the world with mathematics meant to him, and why did we do it. His response:

Reading and writing the world with mathematics for me is interpreting and making our judgment of the social and political reality of our community and the world we live in. At the same time I learned how to make connections with mathematics and the real world. We do it because it helps us understand and combat against oppression and injustice in our communities and in the world. But more importantly, we do it to be educated in knowing what we are fighting against.

References


