

OUR ISSUES, OUR PEOPLE: MATHEMATICS AS OUR WEAPON

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This paper is based on a critical action-research project in a Chicago public school, in a low-income community of color. In the 2008-09 school year, I taught a 12-grade math class in which students used and learned math to study social reality, in particular, aspects of injustice. Math content areas included algebra, discrete math, pre-calculus, probability/data analysis, and quantitative reasoning; the overarching theme was mathematical modelling of reality. Real-world contexts we investigated were whether the 2004 US presidential election was “stolen,” neighborhood displacement (gentrification/immigration/deportation/foreclosures), HIV/AIDS, criminalization of youth/people of color, and sexism. Students used this article’s title to name their end-of-year presentations to their communities about our work in class.

INTRODUCTION

Paulo Freire (1970/1998), among others, posed the question: What should be the purpose of education? He might have answered using words from Amílcar Cabral, one of his mentors. Education can serve “the difficult but inspiring struggle for the liberation of peoples and humankind and against oppression of all kinds in the interest of a better life in a world of peace, security, and progress” (Cabral, 1973, p. 15). How, then, could or should a mathematics class contribute to this struggle? How can one address this question in a mathematics class in an urban neighborhood public school, a district wedded to high-stakes accountability measures, punitive disciplinary policies, what youth call the “school to prison pipeline,” and within a stratified education/social system designed to have education for servitude rather than for emancipation and humanization? Answering this question is a far larger task than one paper can undertake, obviously, but I argue that we can respond to Freire’s question from the perspective of critical mathematics (Frankenstein, 1987; Gutstein, 2006; Skovsmose, 1994) and from a math class in a Chicago public school—a space which we sometimes refer to as “the belly of the belly of the beast”. In this short paper, I provide an example showing what this *can* look like and briefly discuss some concomitant complexities.

In the 2008-09 school year, I taught a 12th-grade mathematics class at the Greater Lawndale/Little Village School for Social Justice (aka “Sojo”). Sojo is 70% Latino/a (mainly Mexican), 30% Black (African American), and 98% low-income. Any student from the neighbourhood may attend. The school, which opened in Fall 2005, grew out of a struggle to build a new high school in an overcrowded Mexican immigrant community, culminating in a 19-day hunger strike in 2001 by neighborhood activists (Russo, 2003). I was part of the design team that founded the school and have been working with administrators, mathematics teachers, and

students there since December 2003, developing and co-teaching critical curricula, and supporting teachers in learning to teach it.

READING AND WRITING THE WORLD WITH MATHEMATICS

Freire's perspectives provide the overarching conceptual framework informing this work. His words guided our class: "Problem-posing education does not and cannot serve the interests of the oppressor. No oppressive order could permit the oppressed to begin to question: Why?" (1970/1998, p. xx). The purpose of our class was that students learned to question: Why? —but specifically, to do so using mathematics, while simultaneously learning the mathematics they needed to both get access to college and economic survival for themselves, family, and community, but also to be able to understand social phenomenon at a deep level. This latter idea is what Freire (1994) referred to as *reading the world*. He was concerned with people learning to read, not as a mechanical exercise, but rather as a way to make meaning out of, and to change, their reality:

From the beginning, we rejected the hypothesis of a purely mechanistic literacy program and considered the problem of teaching adults how to read in relation to the awakening of their consciousness....We wanted a literacy program which would be an introduction to the democratization of culture, a program with men [sic] as its Subjects rather than as patient recipients... (Freire, 1973, p. 43).

Though he rarely discussed math, I have taken his concept of reading the world and built on Frankenstein's (1987) framework to extend it to mathematics. My evolving understanding of *reading the world with mathematics* is:

to use mathematics to understand relations of power, resource inequities, and disparate opportunities between different social groups and to understand explicit discrimination based on race, class, gender, language, and other differences. Further, it means to dissect and deconstruct media and other forms of representation and to use mathematics to examine these various phenomena both in one's immediate life and in the broader social world and to identify relationships and make connections between them. (Gutstein, 2003, p. 45)

Of course, Freire was not satisfied that we learn to read the world because he subscribed to Marx's (1845/1969) observation that the "philosophers have only interpreted the world, in various ways; the point is to change it" (p. 15). Freire referred to this changing reality as *writing the world*:

Reading the world always precedes reading the word, and reading the word implies continually reading the world....In a way, however, we can go further and say that reading the word is not preceded merely by reading the world, but by a certain form of *writing* it, or *rewriting* [emphases original] it, that is, of transforming it by means of conscious, practical work. (Freire & Macedo, 1987, p. 35)

In our class, both reading and writing the world—with mathematics—were very much the agenda. I asked George, a student in our class, what this meant to him, and why he thought we did it. His impromptu written response:

Reading and writing the world with mathematics means a lot. It means that you look at any issue happening anywhere in the world. When you read the world, you are getting background information and seeing why whatever problem you see is occurring. You then find a way to resolve it. This then brings in writing the world with mathematics. When writing the world, you are ready to use mathematics to prove your point. Also, every point you have will not be a solution. It will sometimes just be a way for you to bring light to a situation that no one knows about. So to me this is what reading and writing the world with mathematics means.

We do this for a reason. There are big corporations trying to take advantage of people. There are also plain old injustices that happen everyday. We do this to educate ourselves on global or local problems that can be solved with mathematics. We also do this to learn more advanced mathematics. Lastly, we do this so that we can take our knowledge back to our friends and family to educate them. Once we educate the ones that are closest to us, we then go out and educate our community on how to prevent things from happening to them and how to catch things before they are taken advantage of.

George's insight is clear. Not only did he link the local situation (friends, family, and community) to the globe ("issues happening anywhere in the world"), he understood that math meant both understanding and "resolving" problems, and using math to "prove your point." His justification for why we do this included, again, both the macro ("big corporations trying to take advantage") as well as the micro ("plain old injustices that happen everyday"). And his motivation is clear—to "educate our community" and "prevent things from happening to them."

Was the 2004 (US) Presidential Election Stolen?

To help readers understand how students in urban public schools develop such dispositions toward knowledge, I share some of what George and his classmates actually did in class. We started the year with a 10-week unit titled, "Was the 2004 Presidential Election Stolen?" The rationale was that we were in Chicago (President Obama's town), many of my students were voting for the first time (having turned 18), and several were poll watchers or involved in voter registration campaigns. Chicago went overwhelmingly for Obama—one student was a poll watcher at a voting precinct in her all-Black neighborhood and reported that it went 292-0 for Obama. Given that all Sojo students are of color, the historical significance of the Obama campaign—and the possibility that the 2008 election might be "stolen"—it is not at all surprising that students were so engaged in the unit.

We studied the 2004 election to understand that certain phenomena could *not* have happened by chance, in preparation to monitor and alert the public, in whatever small ways we could, about the 2008 possibilities. Using data from a book, *Was the 2004 Presidential Election Stolen?* (Freeman & Bleifuss, 2004), we investigated what we

called the *poll differences* (PD) between reported votes and exit poll results. Exit polls are anonymous, highly accurate polls conducted immediately *after* individuals vote and have been used internationally to certify the accuracy of elections (e.g., in Ukraine). We expect exit polls to differ from recorded votes, due to sample variation, but the difference in any given precinct should arbitrarily favor one candidate or the other (assuming just two); over a large number of precincts, these disparities should break roughly 50-50 in favor of each candidate (ibid.). However, the 2004 exit poll disparities, in many places, were extremely unlikely. In the 10 so-called “battleground” states (those whose outcomes were highly contested and important), the PDs *all* favored then-President Bush against candidate John Kerry, and in the 50 state polls, the PDs split 44-6 in favor of Bush. We also studied the actual discrepancies within the exit polls in key states. As Maria, a student wrote:

As I showed before, the probability [in the battleground states] was $.9766E-4$, that is about 1 in 1000. Then on the 50 PDs, 44 favored Bush and only 6 favored Kerry. That probability is $1.411E-8$ or about 1 in 100,000,000, almost zero. In Ohio, Kerry won the exit poll with 54.2% but his recorded vote was 48.7%. That chance is about 1 in 1,000,000,000. Does it sound reasonable? At least not by chance.

As Channing, another student, wrote, the math he learned was “a bigger piece of evidence that these events couldn’t, shouldn’t, and wouldn’t happen by chance.”

The unit culminated the week after the election (November 2008) and students collectively wrote an op-ed piece that was published October 31 in the popular on-line news magazine, *Huffington Post* (the website received 4.5 million unique hits in October 2008; see http://www.huffingtonpost.com/robert-koehler/students-ask-are-our-elec_b_139883.html). The op-ed concluded:

Our class is writing this to inform everyone about previous problems in the elections and to warn people to watch for similar troubles. We want to ensure that in this election, the same problems do not occur....In this election, it is up to all of us to question the results and to hold officials accountable for fairness. If the vote changes on the electronic machine, call for assistance. Let your vote be counted for the candidate of your choice. Let your voice be heard, and don't settle for less!

Remember--it didn't happen by chance!

We see this as an instance of *writing the world with mathematics*, that is, using mathematical arguments to advocate a position and fight for what students believe is just. Although I do not include specifics here, and students decided not to put their mathematics in the op-ed piece (knowing most readers would not understand), students learned about binomial and normal probability distributions and confidence intervals, and used their mathematical analyses to conclude that things could not have happened by chance unless one accepts a one-in-1-billion possibility. This was their way of trying to ensure that the 2008 election was honest. As Antoinette wrote: “writing the world with mathematics means being able to use mathematics to address

a real social issue and being able to make a change. Being able to address a point and being able to back it up with mathematics.”

Studying Neighborhood Displacement

After completing the elections unit, we studied neighborhood displacement. Sojo serves two distinct and physically separated low-income neighbourhoods: North Lawndale, almost all Black, and Little Village, primarily Mexican. Displacement has specific meanings in various contexts. In our situation, it first means gentrification, when more well-off people move into low-income communities, as rents, house prices, and property taxes rise, forcing people out. This is particularly the case in North Lawndale. Second, the mortgage and broader global economic crises have severe repercussions for both Sojo communities. Family members have lost jobs due to layoffs, and foreclosures have skyrocketed, including affecting Sojo families. In 2008, almost 10% of all mortgageable units went into foreclosure in North Lawndale. Third, estimates are that thousands of Little Village residents are unauthorized in the US. Displacement, for them, means the possibility of being swept up by US immigration authorities and summarily deported to Mexico. The spectre hangs over the community. In April 2007, in one such raid, “federal agents in full gear, some holding machine guns, surrounded the parking lot of the Discount Mall in Little Village” (Garcia, 2007). And fourth, displacement refers to the impact free trade agreements (e.g., NAFTA) have had on both communities—industrial jobs have been lost in North Lawndale and relocated to parts of the global South, and Mexican farmers have been forced off the land due to the influx of highly subsidized US corn (Oxfam, 2003). Many displaced Mexicans eventually find their way to Little Village, where they exist in shadows, vulnerable and fearful of the other displacement of deportation. Thus displacement was *very* real to my students.

The displacement unit was far-reaching politically and long—it took three months. One key theme was the meaning of *affordability*. Developers were building (or rehabbing) homes in North Lawndale, and prices were rising even in Little Village (at least until the housing crash), so students investigated whether “ordinary” residents could afford to still live in the communities. Students learned that a North Lawndale family with the annual median income (around \$20,250, very low for the US) could afford to buy a house without “hardship” (defined by the US government to be no more than 30% of gross income) of only about \$84,000 at the prevailing interest rate at the time. New condos in North Lawndale were selling for triple that.

A second key idea was for students to understand an aspect of the mathematics of capitalism: how home mortgages work. Given that home foreclosures in both communities have soared (the number in each neighborhood more than tripled from 2005 to 2008), and that subprime, predatory loans hit Black and Latino communities the hardest in the US (Bajas & Fessenden, 2007), this was particularly relevant. There were students in class whose families were either in foreclosure or had lost a home recently (in both communities). We started the unit by me telling the story of one family who had given me permission to interview them and share their tale.

To understand the detailed mathematics of subprime mortgages, students learned to use *discrete dynamical systems* (DDS) (essentially, discrete versions of differential equations; Sandefur, 1993). A DDS has a starting and a recursive equation, and one can iterate them to define a sequence, such as a mortgage amortization schedule. For example, if one has a 30-year (360 month), fixed-rate mortgage with a 6% interest rate (a common scenario with which we started the investigation) and buys a house with a mortgage of \$150,000, the monthly payment (not including escrow items, such as property tax and insurance) is \$899.33. The DDS looks like the following, where U_n represents the balance of the mortgage due at the start of month n :

$$U_1 = 150,000.00$$

$$U_n = U_{n-1} + .005U_{n-1} - 899.33 \text{ [for clarity, we did not initially combine like terms]}$$

Using graphing calculators, students graphed curves of time (X-axis) vs. the unpaid principal balance (Y-axis), traced the values, saw how the curve changed shape (and why) over the 30 years, and examined the values. We analyzed various subprime mortgages, including adjustable-rate, interest-only, balloon, and pay-option loans.

Enacting Critical Mathematics in the Classroom

Reading and writing the world with mathematics entails, among other things, using mathematical ideas to develop sociopolitical consciousness. In this unit, this occurred in several places, including as students examined how much of a monthly payment goes to interest and how much to principal. In Little Village, a family with the median income (\$32,320) can afford, without hardship, a 6%, 30-year fixed-rate mortgage of just under \$135,000, and would pay about \$808 per month. However, over 80% of the first payment goes to the bank for interest, not to pay off principal. And it does not get much better, from the borrower's perspective, until well into the mortgage (e.g., after 15 years, almost 60% of the payment still goes to interest). In fact, after 30 years, the borrower will pay about 291,000, over twice the original amount. This led us to the question of what happens if a Little Village family with the median income wanted a \$150,000 mortgage, somewhat more than the roughly \$135,000 such a family can afford without hardship. Given that their monthly payment would be (maximum) \$808, after 30 years, the family would still owe the bank almost \$92,000 after paying \$291,000 on a \$150,000 mortgage. This astonished and dismayed students, even though I explained, from capital's perspective, the rationale for collecting interest. As we examined this, we had the following dialogue in class.

Mr. Rico: [This is my classroom name] Think about that, after thirty years, you still owe them ninety two thousand, you only borrowed one hundred and fifty. Do some quick math. How much have you paid in thirty years?

Darnisha: Too much money.

[We work through on the overhead calculator that the family has paid about \$291,000.]

- Mr. Rico: [slowly] You've paid two hundred and ninety one thousand dollars, on a hundred and fifty thousand dollar mortgage...
- Alex: [interrupting] Nearly double.
- Mr. Rico: And you still owe ninety two thousand dollars. [pause] Check that math out. That's good math. Let's look at that math. [I write on the board: $150,000 - 291,000 = 92,000$ while saying:] One hundred and fifty thousand minus two hundred and ninety one thousand equals ninety two thousand dollars. [pause] Look at that math. [pause] Think about that. You started with a hundred and fifty—you paid two hundred and ninety one—and you still owe ninety two thousand dollars. Good math, huh? [students are astonished] What's going on here?
- Alex: They're taking your money!
- Darnisha: [in a matter-of-fact tone] The bank is taking advantage of you.
- Mr. Rico: This is legal. This is how banks loan money and make money. [pause] [slowly] This is legal. [pause] [slowly] This is how banks loan money and make money.
- Rut: Wouldn't a family have to pay more than eight hundred and eight a month to be able to afford the one hundred and fifty thousand loan? [she is right]
- Rut: [I then asked students what were their questions.] Why is it legal?
- Mr. Rico: Why is it legal is a really good question.
- Darnisha: Why don't more people look into it? Why don't they have people who look into it, to make sure that their finances are favourable, where they could actually pay it off instead of waiting till after 30 years? [class ended]

This discussion continued over the next several weeks as students carefully analyzed various types of subprime mortgages and discovered, through their own calculations, that these are higher-cost (to the borrower) loans. We also examined data showing that families of color disproportionately received these loans, even when they qualified for prime loans, and thus linked the question of racism in banking practices to the displacement affecting students' communities. As a key way of writing the world with mathematics, the class had agreed to do two public presentations involving all students (one in each neighbourhood) at the end of the school year to inform their communities about issues that students felt were critical to know. They felt it particularly important that they tell neighbourhood adults about displacement and the traps of predatory lending.

Complexities and Risks in Learning to Read and Write the World

This dialogue and our work in this unit (indeed, in the class) raise central questions about critical pedagogy, some of which I briefly discuss here (see Gutstein, 2006 for more). Can education ever be neutral? What is the teacher's ethical and pedagogical responsibility with respect to multiple perspectives? Her own perspective? Affirming

himself while simultaneously not disaffirming students (Freire's terms)? Concretely, how might one teach about capital's math, from within a capitalist country, while providing students space to develop their own views?

To address these issues, I turn to Freire (1994), who wrote:

There neither is, nor has even been, an educational practice in zero space-time—neutral in the sense of being committed only to preponderantly abstract, intangible ideas. To try to get people to believe that there is such a thing as this, and to convince or try to convince the incautious that this is the truth, is indisputably a political practice, whereby an effort is made to soften any possible rebelliousness on the part of those to whom injustice is being done. It is as political as the other practice, which does not conceal—in fact, which proclaims—its political character. (pp. 77-78)

Drawing from Freire, I argue that to *not* analyze the mathematics behind the “injustice being done” to Sojo students (and others) *is* a political practice. People throughout Chicago are being forced out and losing their homes, and communities are being destroyed and “rebirthed” as upscale gentrified spaces, for the “new” people with means. Obviously, fully understanding this process is complicated, as it involves transnational capital, the drive for cities to compete on the global market, and the workings of neoliberal urbanism (Lipman & Haines, 2007). But these young people's lives are affected—by these “political practices.” My goal, as a teacher/researcher/learner is not to “soften any possible rebelliousness” of my students, but to *strengthen* it, through providing them opportunities to use mathematics as a weapon in the struggle for social justice. But does this mean to provide only one view of reality? In contrast, I also build on Freire to address this:

Respecting them [students] means, on the one hand, testifying to them of my choice, and defending it; on the other, it means showing them other options, whenever I teach—no matter what it is that I teach! (p. 78)

What is altogether impermissible, in democratic practice, is for teachers, surreptitiously or otherwise, to impose on their pupils their own “reading of the world,” in whose framework, therefore, they will now situate the teaching of content...The role of the progressive educator, which neither can nor ought to be omitted, in offering her or his “reading the world,” is to bring out the fact that there are other “readings of the world,” different from the one being offered as the educator's own, and at times, antagonistic to it. (pp. 111-112)

Thus, my conscious effort to have students understand that capital, too, has its values and goals, but based on its position in the world. That is why I explained that “this is legal, this is how banks loan money and make money.” Whether students think that this is just or not must be their decision; I did not hide my own views (though I did not always put them out initially), but I challenged and encouraged students to develop their own. Students need to *begin* to understand that the conditions affecting their lives are complex, both global and local, and that they can develop analytical ways of thinking with respect to both mathematics and sociopolitical realities.

Given the above, was I at all concerned that students might take my views without sufficiently questioning and critiquing them? Yes, and at times it happened. That is why, from the first day of class, I told students to question me as much as they question any other view, person, or text. Freire commented on this also: “Is there risk of influencing the students? It is impossible to live, let alone exist, without risks. The important thing is to prepare ourselves to be able to run them well” (p. 79). The goal, regarding this issue, is for students to begin to interrogate their lives and the reasons behind what they experience. This questioning is precisely what a critical mathematics curriculum seeks to engender in students, and is exactly why it threatens. The earlier quote from Freire (1970/1998) speaks clearly to this, “No oppressive order could permit the oppressed to begin to question: Why?” Evidence that Sojo students learned to read and write their worlds with (and without) mathematics come from Vero, who said:

I’ve learned to question how and why...Mr. Rico told me that I was just giving people the mathematical answers...I went from questioning things in math to questioning things in life. Now I question everything and everyone....[I asked her: Why?] Because we’re taking [pause] regular math and implementing it, we use our knowledge to address other issues that affect others, people of color, low-income people, etc.

She continued, turning from mathematics to aspects of her lived reality:

The reason why some people act so aggressive is not because that’s how we are, but because that’s how we are meant to be because of what’s happening to us. So like all the police and stuff, all these North Lawndale shootings, Little Village shootings, another shooting, another kid dead, or something like that, it’s just that that was led by something else. It’s just not, people don’t just pop out with a gun and start shooting. It’s because something is going on that is leading people to do certain things....it’s not a way of excusing it, but it’s a way of addressing the question: Why?

As an end-of-year present, I had t-shirts made for all my students, depending on whether they were Latina/o or Black. The t-shirts read, on the back, *SOJO-2009; Math for Social Justice*, and on the front, *Danger—Educated Black Woman* (or Man) or *Danger—Educated Latina* (or Latino). Vero, as an educated Latina, poses the danger to the status quo because she is educated, and through her critical education, is beginning to ask the question: Why?

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