Introduction

I thought math was just a subject they implanted on us just because they felt like it, but now I realize that you could use math to defend your rights and realize the injustices around you. ... Now I think math is truly necessary and, I have to admit it, kinda cool. It’s sort of like a pass you could use to try to make the world a better place.

— Freida, 9th grade, Chicago Public Schools

Some students would prefer to have a dentist drill their teeth than to sit through a math class. Others view math class as a necessary but evil part of getting through school. Still others enjoy playing and working with numbers and problems.

We agree with Freida. Math is often taught in ways divorced from the real world. The alternative we propose in this book is to teach math in a way that helps students more clearly understand their lives in relation to their surroundings, and to see math as a tool to help make the world more equal and just.

In a “rethought” math class, teachers make mathematics more lively, accessible, and personally meaningful for students, who in turn learn in more depth.

The articles in this book provide examples of how to weave social justice issues throughout the mathematics curriculum and how to integrate mathematics into other curricular areas. This approach seeks to deepen students’ understanding of society and to prepare them to be critical, active participants in a democracy.
The elementary school, middle school, high school, and college teachers who have contributed to this book also note the many potential benefits of such a social justice approach to mathematics. Among them:

- Students can recognize the power of mathematics as an essential analytical tool to understand and potentially change the world, rather than merely regarding math as a collection of disconnected rules to be rote memorized and regurgitated.
- Students can deepen their understanding of important social issues, such as racism and sexism, as well as ecology and social class.
- Students can connect math with their own cultural and community histories and can appreciate the contributions that various cultures and peoples have made to mathematics.
- Students can understand their own power as active citizens in building a democratic society and become equipped to play a more active role in that society.
- Students can become more motivated to learn important mathematics.

These benefits come both when teachers reshape the mathematics curriculum with a social justice vision and when they integrate social justice mathematics across the curriculum into other subjects, such as social studies, science, health, reading, and writing.

**An Essential Tool for Understanding and Changing the World**

To have more than a surface understanding of important social and political issues, mathematics is essential. Without mathematics, it is impossible to fully understand a government budget, the impact of a war, the meaning of a national debt, or the long-term effects of a proposal such as the privatization of Social Security. The same is true with other social, ecological, and cultural issues: You need mathematics to have a deep grasp of the influence of advertising on children; the level of pollutants in the water, air, and soil; and the dangers of the chemicals in the food we eat. Math helps students understand these issues, to see them in ways that are impossible without math; for example, by visually displaying data in graphs that otherwise might be incomprehensible or seemingly meaningless.

As an example, consider racial profiling. This issue only becomes meaningful when viewed through a mathematical lens, whether or not the “viewer” appreciates that she or he is using mathematics. That is, it is difficult to declare that racial profiling occurs unless there is a sufficiently large data set and a way to examine that data. If, for example, 30 percent of drivers in a given area are African Americans, and the police stop six African American drivers and four white drivers, there is weak evidence that racial profiling exists. But if police stop 612 African American drivers and 423 whites, then there is a much stronger case.

The explanation lies in mathematics: In an area where only 30 percent of the drivers are black, it is virtually impossible for almost 60 percent of more than 1,000 people stopped randomly by the police to be black.

The underlying mathematical ideas—(dis)proportionality, probability, randomness, sample size, and the law of large numbers (that over a sufficiently large data set, the results of a probability simulation or of real-world experiences should approximate the theoretical probabilities)—all become part of the context that students must understand to really see, and in turn demonstrate, that something is amiss. Thus with a large data set, one can assert that a real problem exists and further investigate racial profiling. For youth, racial profiling may mean being “picked on,” but the subtleties and implications are only comprehensible when the mathematical ideas are there. (See “Driving While Black or Brown,” page 16.)

When teachers weave social justice into the math curriculum and promote social justice math “across the curriculum,” students’ understanding of important social matters deepens. When teachers use data on sweatshop wages to teach
accounting to high school students or multi-digit multiplication to upper-elementary students, students can learn math, but they can also learn something about the lives of people in various parts of the world and the relationship between the things we consume and their living conditions. (See “Sweatshop Accounting,” page 78, and “Sweatshop Math,” page 256.)

Moreover, to understand some issues, students need to combine math with other subjects. For example, although the government releases unemployment figures monthly, Marilyn Frankenstein explains in “Reading the World with Math” (page 30) that how unemployment figures are reported profoundly affects one’s understanding of what really goes on in our communities. Frankenstein points out that it’s easy enough to figure unemployment percentages, but who gets counted as unemployed and who is—or is not—considered part of the workforce are political questions. The unemployment rate changes depending on these decisions. Thus math needs social studies, and social studies needs math.

**Connecting Math with Students’ Cultural and Community Histories**

Rethinking math also means using culturally relevant practices that build on the knowledge and experiences of students and their communities. Many of these approaches have been developed by teachers and then described and theorized by researchers of color, such as Gloria Ladson-Billings and William Tate. A guiding principle behind much of this work is that teachers should view students’ home cultures and languages as strengths upon which to build, rather than as deficits for which to compensate. In “Race, Retrenchment, and the Reform of School Mathematics” (page 42), Tate offers the simple example of a teacher’s failure to reach her students because she uses story problems that are not grounded in the students’ culture; while Luis Ortiz-Franco (“Chicanos Have Math in Their Blood,” page 95) encourages teachers to teach about the base 20 Mayan number system as a way to emphasize, to both Chicano students and others, that math has deep roots in indigenous cultures in the Americas. David Levine’s article about the Algebra Project started by Bob Moses (see “Radical Equations,” page 147) provides another example of teachers connecting with students’ cultural and community histories to promote deeper student learning. Moses summarized the importance of these connections in his book on the project:

[In the Algebra Project we are using a version of experiential learning; it starts with where the children are, experiences that they share. We get them to reflect on these, drawing on their common culture, then to form abstract conceptualizations out of their reflection, and then to apply the abstraction back on their experience. You can think of it as a circle or clock: At 12 noon students have an experience; at a quarter past they are thinking about it; at half past they are doing some conceptual work around their reflections; and at a quarter to they are doing applications based on their conceptual work. In the Algebra Project this movement from experience to abstraction takes the form of a five-step process that introduces students to the idea that many important concepts of elementary algebra may be accessed through ordinary experiences. Each step is designed to help students bridge the transition from real life to mathematical language and operations. Because of this connection with real life, the transition curriculum is not only experiential; it is also culturally based. The experiences must be meaningful in terms of the daily life and culture of the students. One key pedagogical problem addressed by the curriculum is that of providing an environment where students can explore these ideas and effectively move toward their standard expression in school mathematics.]}
Understanding Their Power as Active Citizens

As students develop deeper understandings of social and ecological problems that we face, they also often recognize the importance of acting on their beliefs. This notion of nurturing what Henry Giroux has called “civic courage”—acting as if we live in a democracy—should be part of all educational settings, including mathematics classrooms.

Rethinking Mathematics spotlights several examples of student activism. These include 5th-grade Milwaukee students writing letters to social studies textbook publishers based on their mathematical analysis of slaveholding presidents and textbooks’ failure to address this issue (see “Write the Truth,” page 226); New York City students who measured their school space, calculated inequalities, and then spoke out against these inequities in public forums (see “‘With Math, It’s Like You Have More Defense,’” page 129); and students who used math to convince their school administration to stop making so many obtrusive PA announcements (see the activity “Tracking PA Announcements,” page 208).

Motivated to Learn Important Math

Engaging students in mathematics within social justice contexts increases students’ interest in math and also helps them learn important mathematics. Once they are engaged in a project, like finding the concentration of liquor stores in their neighborhood and comparing it to the concentration of liquor stores in a different community, they recognize the necessity and value of understanding concepts of area, density, and ratio. These topics are often approached abstractly or, at best, in relation to trivial subjects. Social justice math implicitly tells students: These skills help you understand your own lives—and the broader world—more clearly.

Getting Started

Teachers and preservice teachers sometimes ask: How do I get started integrating social justice concepts in my math class? Our best advice is to take a little at a time. One way is to identify a concept/skill that you are teaching as part of your regular curriculum and relate it to a lesson idea in this book (or on the website for this book, www.rethinkingschools.org/math). Teach the lesson or unit and then gauge how successful it was in terms of student motivation, student understanding of the math concepts, and the deepening of the students’ knowledge about the particular social issue.

Another way is to get to know your students and their communities well and listen closely to the issues they bring up. Many of our own social justice projects started from conversations with students about their lives or from knowing about issues in their communities. For example, see the activity “Environmental Hazards,” page 52, in which high school students investigate contamination in their own neighborhoods.

The media are also potential sources of projects, because current issues both affect students’ lives and have mathematical components that teachers can develop into social justice projects. For example, see “Home Buying While Brown or Black,” page 61.

Certainly working in a school that has a conceptually strong foundational mathematics curriculum is helpful. Teachers cannot easily do social justice mathematics teaching when using a rote, procedure-oriented mathematics curriculum. Likewise a text-driven, teacher-centered approach does not foster the kind of questioning and reflection that should take place in all classrooms, including those where math is studied.

By saying this, we do not wish to imply that if teachers use a conceptually based curriculum that embraces the standards put forth by the National Council of Teachers of Mathematics (NCTM)—such as Investigations in the elementary grades, Mathematics in Context or Connected Mathematics Project for the middle grades, and Interactive Mathematics Program in high school—such a curriculum will automatically guide students towards a social justice orientation. In fact, these programs have an unfortunate scarcity of social justice connections. But a strong,
conceptually based foundational curriculum can be a great asset to social justice math teaching, because it can encourage students to critique answers, question assumptions, and justify reasoning. These are all important dispositions toward knowledge that teachers can integrate into their social justice pedagogy.

Occasionally, a teacher needs to defend this kind of curriculum to supervisors, colleagues, or parents. One approach is to survey your state’s math standards (or the national standards) and to find references to “critical thinking” or “problem-solving” and use those to explain your curriculum. Also, the NCTM clearly states that “mathematical connections” between curriculum and students’ lives are important.

But it’s important for teachers to recognize that social justice math is not something to sneak into the cracks of the curriculum. It’s not something about which we should feel defensive. What we’re talking about here is something that helps students learn rich mathematics, motivates them, and is really what math is all about. A social justice approach to math is the appropriate type of math for these unjust times. Other, traditional forms of math are often too abstract, promote student failure and self-doubt, and, frankly, are immoral in a world as unjust as ours. Traditional math is bad for students and bad for society.

Views on Math and Social Justice

The two of us have been teaching math for a combined total of more than 50 years—one of us in a bilingual 5th-grade classroom in a public elementary school and the other in inner-city public middle and high schools, in alternative high schools, and at the college level. Our perspectives on teaching math for social justice have been shaped by our own involvement in movements for social justice during the past four decades—the Civil Rights Movement, anti-war movements, educational justice movements, and other campaigns. We’ve also been influenced by educators such as the late Brazilian educator Paulo Freire, who argued against a “banking approach” to education in which “knowledge” is deposited into the heads of students and in favor of “problem-posing” approaches in which students and teachers together attempt to understand and eventually change their communities and the broader world.

Math has the power to help us understand and potentially change the world.

In addition to the benefits outlined at the beginning of this introduction, an important aspect of a social justice approach to teaching math is that it must include opening up the “gates” that have historically kept students of color, women, working-class and low-income students, and students with perceived disabilities out of advanced mathematics tracks and course offerings. The Algebra Project mentioned above, for example, seeks to ensure that “gatekeeper” classes like algebra don’t prevent large numbers of historically disenfranchised students from succeeding in higher education. (For information on other such projects, see Resources, page 259.)

Those who wrote for this book, and those who write for the magazine Rethinking Schools, are always encouraged not only to explain what they teach and why they try certain things, but to reflect on how they would do things differently next time. In that spirit we recognize that, as white male educators, our experiences have their own limitations and, if we were to do this book over, we would work harder to increase the representation of authors of color. We encourage all educators who teach math, particularly educators of color, to write about their experiences teaching math for social justice and to consider...
submitting articles for possible publication in *Rethinking Schools*.

**Isn’t Math Teaching Neutral?**

While reading these articles, some people might question whether it’s appropriate to interject social or political issues into mathematics. Shouldn’t math teachers and curriculum, they might say, remain “neutral?”

Simply put, teaching math in a neutral manner is not possible. No math teaching—no teaching of any kind, for that matter—is actually “neutral,” although some teachers may be unaware of this. As historian Howard Zinn once wrote: “In a world where justice is mal-distributed, there is no such thing as a neutral or representative recapitulation of the facts.”

For example: Let’s say two teachers use word problems to teach double-digit multiplication and problem-solving skills. They each present a problem to their students. The first teacher presents this one:

A group of youth aged 14, 15, and 16 go to the store. Candy bars are on sale for 43¢ each. They buy a total of 12 candy bars. How much do they spend, not including tax?

The second teacher, meanwhile, offers a very different problem:

Factory workers aged 14, 15, and 16 in Honduras make McKids children’s clothing for Walmart. Each worker earns 43 cents an hour and works a 14-hour shift each day. How much does each worker make in one day, excluding any fees deducted by employers?

While both problems are valid examples of applying multi-digit multiplication, each has more to say as well. The first example has a subtext of consumerism and unhealthy eating habits; the second has an explicit text of global awareness and empathy. Both are political, in that each highlights important social relations.

When teachers fail to include math problems that help students confront important global issues, or when they don’t bring out the underlying implications of problems like the first example here, these are political choices, whether the teachers recognize them as such or not. These choices teach students three things:

1. They suggest that politics are not relevant to everyday situations.
2. They cast mathematics as having no role in understanding social injustice and power imbalances.
3. They provide students with no experience using math to make sense of, and try to change, unjust situations.

These all contribute to disempowering students and are objectively political acts, though not necessarily conscious ones.

As high school teacher Larry Steele details in his article “Sweatshop Accounting” (page 78), the seemingly neutral high school accounting curriculum in fact approaches the world in terms of markets and profit-making opportunities. Not everything that counts gets counted, Steele says, and thus the “neutral” curriculum actually reinforces the status quo.

We believe it’s time to start counting that which counts. To paraphrase Freida, the 9th grader quoted above, we need to encourage students to defend their rights and to recognize the injustices around them. By counting, analyzing, and acting, we will help students and ourselves better read the world and remake it into a more just place.

*Eric (Rico) Gutstein and Bob Peterson*
Adventures of a Beginning Teacher with Social Justice Mathematics

By Liz Trexler

It was during my first semester of student teaching at King College Prep High School (92 percent African American) in Chicago Public Schools that I was inspired to create my first social justice mathematics lesson. Having looked through student interest surveys, I discovered that many of my students suffered from asthma—a common ailment stemming from genetics and poor air quality. In my Algebra I class, we connected proportional reasoning to patterns and rates of children with asthma in Chicago by comparing data from particular neighborhoods.

After the lesson, I wondered how effective mathematics in this context was in developing a deeper mathematical understanding. Sure, my students appeared more engaged than if we were just doing traditional math, but how was I to be sure that their proportional reasoning benefited from this? During the lesson, several students asked, “Isn’t this math class?” or “Why are we talking about asthma?” When they posed this question in other classes, in looking at charts or making sense of problems in science and social studies, did they recognize that they were reasoning mathematically? This led me to the question: Do students perceive social justice mathematics as being relevant to their daily lives?
I turned to the most valuable source I had in my classroom: my students. I formed a focus group of 15 students to get a sense of what they considered meaningful mathematics. I asked what gives them the most problems in mathematics, what makes a problem “real-world,” and to describe who and what a mathematician is. Every response to this last question—one who knows math inside and out, someone who majors in math, a person who understands concepts and formulas and when to apply them—involved being somewhat of a “genius,” as the students put it. When I asked whether they saw themselves as mathematicians, most responded that they were not confident and/or knowledgeable enough to earn this title. I wanted to inspire them to change this perception. To me, a mathematician is a person who can not only apply mathematical concepts, but can also use them to make sense of the social, political, and economic world in which they live.

Being able to use a concept on a daily basis seemed to be valuable to them. One student said, “If you talked about texting, I guarantee you everyone in this classroom would listen. We love texting.” Although I could easily incorporate this into the curriculum, I asked myself, “Would I be integrating this because it would provide a rich mathematical experience or to please my students?” This topic may be relevant to them, but they would not necessarily gain a better understanding of an algebra concept or an injustice in their world merely because I mentioned texting. I would need to situate the mathematics in meaningful contexts for my students to truly understand how math could reveal things about their world.

When I asked for characteristics of a real-world problem, they responded that it was something that related to students. I asked a follow-up question: Is it possible to create one question that would relate and resonate with each and every student in the classroom? They all told me probably not. This was something that I never thought about. Many application problems can indeed be real-world, but perhaps not for every learner.

I also had students evaluate three math problems (below)—rating how real-world each problem was, how much the problem interested them, and how the problem helped them to make better sense of the world they lived in.

1. Several students go to the store. They buy 12 candy bars that all cost the same and spend $5.16. How much does each candy bar cost?
2. A factory worker in Honduras works 12 hours a day and earns $5.16 in daily wages. How much does he/she earn per hour?
3. It costs $1.50 each way to ride the bus between home and work. A weekly pass is $16. Which is a better deal, paying the daily fare or buying the weekly pass?

The results in comparing problem #1 and #2 were interesting. Although more students felt that #2 better informed them about other situations in the world, they felt that problem #1 helped them make better sense of their own world. The majority of the group also felt that problem #1 was more effective in getting the math concept across. Clearly, students would encounter a situation such as buying candy more on a day-to-day basis than calculating wages of children in poor countries, so they evidently felt better connected to problem #1. However, would I have gotten the same response if I had changed #2 to read, “In your first after-school job, you work 12 hours a day and earn $5.16 in daily wages”? Would putting them in the context of the problem make them evaluate it any differently?

Students rated number #3 the most real-world by far. As they worked, one student asked, “Does a week mean five days or seven days?” Another asked if riders were making transfers on the bus. Yet another asked if they should count Sunday, since many people didn’t work on Sundays. Although written for a standardized
of the classroom. Although I brought in topics of social justice to accompany the math, the math itself did not always highlight these issues.

I decided that I would make another attempt at creating a lesson involving a social justice topic using my newly acquired understandings. After my year of student teaching in Chicago, I moved to Denver to officially begin my teaching career in a small district where the student population is 80 percent Latina/o and 85 percent of students qualify for free or reduced lunch. Although the socioeconomic status of my students in Denver was similar to my students in Chicago, the surrounding neighborhood and community created some apparent differences in academic culture. One main difference between my students in Chicago and those in Denver was the percentage of students who pursued postsecondary options. Of the graduating class of 2011 at my high school in Denver, only 35 percent of students continued their education beyond high school. At King College Prep, 85 percent of students pursued postsecondary opportunities.

Since I have been teaching in Denver, there has been a big push to increase awareness of postsecondary opportunities for students in

---

**UNDERGRADUATE RESIDENT TUITION AT COLORADO STATE UNIVERSITY**
*(BASED ON 30 CREDIT HOURS)*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>$3,381</td>
<td>$3,466</td>
<td>$4,040</td>
<td>$4,424</td>
<td>$4,822</td>
<td>$5,256</td>
<td>$6,307</td>
<td>$6,875</td>
</tr>
</tbody>
</table>

**UNDERGRADUATE NONRESIDENT TUITION AT COLORADO STATE UNIVERSITY**
*(BASED ON 30 CREDIT HOURS)*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>$14,343</td>
<td>$14,994</td>
<td>$17,480</td>
<td>$20,140</td>
<td>$20,744</td>
<td>$21,366</td>
<td>$22,007</td>
<td>$22,667</td>
</tr>
</tbody>
</table>
hopes of increasing the percentage of students who pursue these options. In my linear functions unit for my Algebra II class, I thought students could benefit from examining and comparing tuition rates between colleges, as well as trends over time, since the cost of attending college has steadily increased. I told my students that we would use linear regression to analyze tuition trends at Colorado State University, the closest state university to our high school, as shown on page 56.

I asked students to write down one question that this data evoked. Most of their questions asked, “How much will tuition be when I am a freshman in college?” This was obviously relevant and necessary if they were to financially plan for college. They could also investigate this using mathematics. However, several students thought more in-depth, asking, “Why does tuition increase more in certain years than others?” and, “Why is nonresident tuition so much more?” These questions didn’t necessarily address the math concepts we were studying, but were helpful in understanding the problem context.

My students already knew how to use a graphing calculator to input data and find the line of best fit. However, I wanted to use the characteristics and information provided by the equation of the line of best fit, in slope-intercept form, to compare the scenarios.

Using linear regression on the data above, we obtained the following equations in slope-intercept form (where $x$ is the number of years since 2005–06 and $y$ is the cost of tuition for that year):

Resident Tuition:
\[ y = 508.44x + 3,041.83 \]

Nonresident Tuition:
\[ y = 1,257.08x + 14,817.83 \]

Several questions immediately arise. What do these numbers mean in the context of the problem? In order for students to analyze and make inferences from the data, they first needed to understand what the slope and y-intercept represented in the real-world context beyond the equation or the graph. From the equation, we can see that resident tuition in 2005–06 (when $x = 0$) should be $3,041.83. However, from the table, we see that tuition was actually $3,381. This may cause students to question, “Why is it different? What do the intercepts tell us about approximation and lines of best fit?” From this data alone, students can use math to inform their own thinking and ask more personal questions, such as, “Will this affect me?” or, “How much more expensive will tuition be when I attend college in a few years?”

Another helpful question in analyzing the data would be: “If we looked at a subset of the data, how would these equations change?” For example, if we examined only tuition for 2009–2013, how would our slopes and intercepts change? Would this be a better model to predict the cost of tuition in the immediate future? In answering these questions, students not only demonstrate their understanding of what creates an equation, but the math can also become a springboard for further investigation.

One key aspect that highlighted an injustice specific to my students was the difference in the slope between a resident and nonresident student. For a student attending Colorado State University as a resident, one could predict tuition to increase by $508.44 each year. For a student attending as a nonresident, tuition was predicted to increase by $1,257.08 each year. The response to the question, “Is this fair that they have to pay more to get the same education just because they don’t have a piece of paper?”
residential vs. nonresidential tuition?” is fairly simple for most: Resident means you reside in that state and nonresident means you do not.

However, many of my students are undocumented, which meant that if they wanted to attend Colorado State University or any other public university in Colorado, they would pay nonresident tuition. One undocumented student realized that over the course of four years, he would pay nearly $63,000 more than his friend who is documented. This caused another student to ask, “Is this fair that they have to pay more to get the same education just because they don’t have a piece of paper?”

These low-income students who already have difficulty affording college regardless of immigration status saw how the trends in tuition prices disproportionately affect particular populations, making it harder for undocumented students to pursue the same opportunities as their documented peers. By the end of the lesson, I felt that my students had not only explored concepts of linear regression, but they also recognized how useful this tool could be to analyze their future. The comments and discussions I heard between students illuminated an injustice in their own community.

Upon reflecting on my initial lessons from student teaching, I realized that I was putting too much effort into creating an ideal, super lesson that would take a topic of social justice and then integrate the math into it. The mathematics in a situation should highlight questions and concepts of social justice to create a cohesive and authentic opportunity to investigate. That is what I tried to do with the tuition context.

According to Bob Peterson in the first edition of Rethinking Mathematics, if students do not see how math applies to their lives, they are “robbed of an important tool to help them fully participate in society.” Seeing math as a means of investigation is one way that students can begin to view math as the invaluable tool that Peterson describes. It can also serve as an entry point to more involved conversations. If we are to encourage students to use math to make sense of the world around them, we need to provide them with mathematical contexts that give them the experience in doing so.

I hope that motivating students to use mathematics as a tool rather than just a subject they have to take can change the question of, “When will I use this?” to, “How can I use mathematics to make sense of the reality in which I live?”