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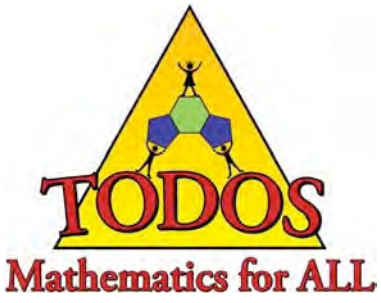
Teaching for Excellence and Equity in Mathematics

Special Issue

Mathematics Education: Through the Lens of Social Justice



An Affiliate Organization of the National Council of Teachers of Mathematics

Special Issue
Mathematics Education: Through the Lens of Social Justice

Editors

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The mission of TODOS: Mathematics for ALL is to advocate for equity and high quality mathematics education for all students — in particular, Latina/o students.

TEACHING FOR EXCELLENCE AND EQUITY IN MATHEMATICS

Teaching for Excellence and Equity in Mathematics

IN THIS ISSUE

From the Editors of TEEM Special Issue
Mathematics Education:
Through the Lens of Social Justice

Recent events in our nation have renewed the urgency to re-examine the role of education in the lives of people historically marginalized in our country. The racial, cultural, and socio-economic demographic shifts have produced a new norm in our public schools. Unfortunately, the current educational system does not equitably educate our youth. Our educational inequities are historical and systemic: grounded in the legacies of slavery, segregation and other forms of institutional discrimination based on race, class, gender, culture, and language. This is particularly evident in mathematics education. Institutional tools that implicate mathematics like standardized tests, ability groups, and curricular tracking systems contribute to the widespread use of pervasive deficit language to rank and sort children. This often results in permanent labels about children's intellectual capacities, family and cultural upbringing and general educability. Mathematics education is a key gatekeeper in this unjust system.

What can we do to dismantle institutional structures (inside and outside the classroom) that perpetuate these inequities in mathematics teaching and learning? What are we doing to transform mathematics education that leads to a more socially just mathematically competent citizenry?

For this *TEEM* special issue on mathematics education through the lens of social justice, we sought manuscripts from classroom teachers, teacher educators, and other interested scholars whose work involves mathematics teaching and learning from a social justice perspective. By social justice perspective, we mean work that has explicitly disrupted institutional structures, policies and practices to advocate for and advance children, historically underrepresented in STEM fields, in learning rich, rigorous and relevant mathematics. Transforming mathematics from a tool of systemic oppression to one of liberation that engages all of us: students, families, and educators in experiencing mathematics in a more just and humanizing way.

Each article in this special issue provides ideas, strategies and resources for this challenging work. Each author highlights the promises, tensions, and struggles of engaging themselves and others, whether it is PreK-12 students or preservice and veteran teachers, in fundamentally changing the experience of learning and teaching mathematics. And each article affirms the importance of mathematics in our lives.

The lead article in this special issue is a conversation with mathematics education scholar Danny Martin, whose seminal work on race, racism, and the mathematics socialization of African Americans provides important understandings about social forces that impact the mathematical experiences and identities of people from a critical perspective. In this conversation, Martin discusses the idea of radical imagination in mathematics education that spotlights racial justice needed for fundamentally transforming how people, particularly young people, experience mathematics in and out of school. Martin highlights his own struggles and what he is learning from his own work, teacher education collaborations, and historical accounts to move forward in transforming mathematics education for the better.

While young children can express ideas of fairness, very few examples exist of mathematizing those conceptions of fairness to address systemic racism. Teacher educator Theodore Chao and pre-school teacher DeAndrea Jones demonstrate how young children can learn fundamental early numeracy concepts and critically examine historical civil rights struggles such as slavery and segregation through play and storytelling. This article provides pre-school aged activities with mathematical extensions for older elementary students to deepen their mathematical and historical knowledge base and develop an activist skill set to navigate a currently unjust world and positively transform their own lives and communities.

Situated in an introductory mathematics course at the high school level, McNeil and Fairley describe an interdisciplinary (language arts and mathematics) project with social justice goals. Using the classic play, *A Raisin in the Sun* by Black playwright and activist Lorraine Hansberry as the context, students learned about linear and exponential functions while also learning about the injustices towards Black Americans. The article describes the different components of this project and includes students' reflections on the impact it had on them.

In "Methods, Maps, and Meaningful Mathematics", Zavala shares part of her journey towards becoming a critical mathematics educator. She describes how she implemented a mathematics activity with social justice implications with her bilingual preservice teachers and what she learned through this experience. Her detailed description of her process provides a valuable resource for mathematics teacher educators who want to support preservice teachers in their learning to teach within a social justice framework.

Felton-Koestler, Sutherland, and Tracy share their experiences in a mathematics content course for preservice elementary teachers that use projects aimed at supporting the students in the use of mathematics to understand the world within a social justice perspective. Sutherland and Tracy, at the time two of the students in Felton-Koestler's course, describe the projects they chose (teacher pay and school lunches, respectively) and the kinds of connections they made between the context of the project and the mathematical ideas. Felton-Koestler offers an analysis on these projects showing areas for further probing in terms of social justice issues.

In the final article of this issue, Rochelle Gutiérrez describes professional acts of creative insubordination that center student advocacy in the teaching mathematics. Through her work with pre-service and in-service teachers, Gutiérrez describes successful strategies to challenge institutional and individual acts of discrimination that serve to harm students and diminish the richness of learning mathematics. Realistic and school-based, these acts of creative insubordination provide language and practice for educators who are committed to students and advocating for a just and equitable mathematics education and find themselves in situations that demand rejection of the status quo.

It is important to understand that the work of mathematics education from a social justice standpoint is always evolving and never a finished product. The articles of this special issue offer foundational frameworks, substantive strategies and classroom-based activities that are replicable and challenging. As a companion piece to this special issue we encourage you to read the National Council of Supervisors of Mathematics and TODOS: Mathematics For All joint position statement on social justice in mathematics education. http://www.todos-math.org/socialjustice

We hope that the ideas and resources of this issue can serve as guideposts for your own journey to make mathematics a more peaceful, just and equitable experience for our nation's youth.

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Acknowledgement: We would like to thank all the reviewers for their service for this special issue. Their names will be listed among the reviewers for 2014-2016 in the next regular issue of *TEEM*. Special thanks to Rocio Benedicto, Carol A. Edwards and Bob McDonald of the TODOS board for editing and formatting assistance.

Call for Manuscripts

We encourage the submission of manuscripts that are aligned with the mission of TODOS: Mathematics for ALL (see p. 2). Manuscripts in applied or action research, literature surveys, thematic bibliographies, commentary on critical issues in the field, professional development strategies, and classroom activities and resources are encouraged and welcome.

Please see **http://www.todos-math.org/teem** for guidelines and then submit complete manuscripts to **teem@todos-math.org.** *TEEM* Editors welcome query emails on the suitability of topics or approaches.

Call for Reviewers

Refereeing is not only a valuable experience and service to the profession, but is also an essential means to ensure that articles of high quality and relevance are published in a timely manner. To be eligible to be a reviewer (normally one manuscript per year), we invite you to send an email to **teem@todos-math.org** with the following information:

- Full name, affiliation, and contact information (including email, phone number, fax number, and mailing address);
- Grade levels (e.g., elementary, middle, secondary, college) where you have teaching or research experience; and
- Thematic areas with which you have particular interest and expertise, and any other pertinent professional information.

Your information will assist the editors in assigning papers to the various reviewers.

TODOS LIVE! Webinar Available: "Reviewing and Writing for TEEM"

On July 22, 2013, Lawrence Lesser conducted a live webinar that explored the big picture and process for reviewing and writing for *TEEM*. The target audience includes classroom teachers, coach-es, administrators, curriculum coordinators, professional developers and university/college faculty. Use the link below to access the recorded webinar.

http://tinyurl.com/TODOSTEEM

Mathematics Education and Social Justice: A Conversation with Danny Martin

Julia M. Aguirre
University of Washington Tacoma

Abstract

Danny Martin is a professor of Education and Mathematics and University of Illinois Chicago. His groundbreaking scholarship on the mathematics socialization of African Americans has led to seminal pieces on the roles of race, identity, and mathematics education for Black children that critically inform current dialogues about mathematics education and social justice. His work inspires many scholars, teacher educators and teachers working to transform mathematical experiences of young people, especially those historically marginalized in schools. We have known each other for 20 years and have co-authored a book together. He is my friend and colleague, someone I continue to learn with and from in the fight for an equitable and just mathematics education for our nation's youth. He sat down with me to discuss mathematics education from a lens of social justice. Our conversation expresses evolving views of the mathematics education landscape including why social justice in mathematics education is so important yet challenging; and, what solutions we can radically reimagine as we try to move forward to create the kind of just and humanizing mathematics education we want.

Julia Maria Aguirre (jaguirre@uw.edu) is an associate professor of education at the University of Washington Tacoma. Her research interests include equity and social justice in mathematics teaching and learning, teacher education, and culturally responsive mathematics pedagogy.

Mathematics Education and Social Justice: A Conversation with Danny Martin

Julia M. Aguirre

Julia Aguirre:
Why is mathematics education a social justice issue?

Danny Martin:
Mathematics education is part of the American system. Concerns in our field are, or should be, embedded within a set of larger issues like social justice, racial justice, and economic justice. Schooling, and mathematics education in particular, is just one context of many where the struggle continues: the struggle for just outcomes, the struggle for just experiences and equitable treatment, the struggle against the pathologizing of specific groups and bodies, and struggles against limited opportunities. So math education is not immune. And, while math education is a hopeful context, we need to interrogate it for its role in reproducing those inequities that make a social justice movement even necessary. It is not neutral in the landscape.

Julia Aguirre:
How does your work in mathematics education connect to social justice?

Danny Martin:
My work foregrounds the experiences and outcomes of Black students. That is one thing it does very explicitly. Second, I am very explicit about issues of race – racial justice, racialized treatment, racialized experiences, and racial hierarchy, with respect to Black learners and other learners. Not only how Black learners experience race, racialization, and racialized outcomes but how all learners are impacted by what we know as a socially constructed phenomenon. It includes intersectional concerns; race and class, race and gender, and race and place. Third, I ask questions about the nature of the field. I've talked about math education as a *white institutional space* in terms of demographics, ideology, policy and all that. I've also raised the question of what kind of project is math education? On the one hand, as I said earlier, it has this hopeful side as a social justice project. But it has also, over the years, been in service of other kinds of projects that seem to work against social justice.

Julia Aguirre:

Tell me more about how mathematics education is a hopeful social justice project.

Danny Martin:
Mathematics education can change lives and change society. In my own life, I have benefitted in many ways from the mathematics education that I received. And I can use mathematics to help me understand my place in the world and why things are the way they are for me and for others. I don't think that should be an exceptional experience. And I think we have many examples of how teachers and young students, for example, are using the mathematics that is accessible to them to understand and change their lives and the world they live in.

Julia Aguirre:
I want to ask you about your early work. You were one of the first people to speak from a scholarship standpoint and very eloquently about Black socialization in mathematics. And, I'm going to ask you to think about that work in relation to the adults you interviewed and the kids you engaged and then ask you to connect to the teacher education work you are involved with for our TEEM audience of teachers, math teacher educators, and scholars.

Danny Martin:
The early work I was doing with Black learners, which included adult learners, parents, and middle schoolers, it didn't really have a teacher education focus. It was initially about the experiences these folks were having. The experiential piece and the identity piece came along with it. But what I think was really interesting was how the narratives from those adults on their schooling experiences and the experiences of their children and the narratives of those young folks, middle school students, were

actually commentaries about the nature of schooling. There is a lot of information in those commentaries to share with teachers; surfacing for teachers through the voices of Black learners, their mathematics education experiences and their schooling experiences. And, how those experiences implicated teachers and particular forms of pedagogy and particular kinds of interactions to those adults who went back 20, 30, even 40 years, in some cases, to talk about the teachers that they remembered, the episodes in the classrooms, and the impact it had on their lives. That was all very powerful and revelatory because I did not go in with the idea of focusing on the implications for teacher education.

Julia Aguirre:
Why is the struggle for equity and justice in mathematics education so difficult?

Danny Martin:
I think part of it has to do with the fact that it is mathematics. Mathematics has this mystique and aura, that we, and others, have been pushing back on for decades; that mathematics is culture free and context free and has nothing to do with issues of race, identity, and power. It was somehow above the fray. That myth is being shattered. I think there is inertia and recalcitrance with certain corners that really want to keep it the way it is; that math should not be about delving into social issues. If we take this idea of math education as a white institutional space, I think in preserving white interests and making things seem neutral and colorblind, the attention to race, power, and identity has sometimes been thwarted or muted.

Julia Aguirre:
Maybe the context for this question should have been different. Why is the struggle for racial equity or racial justice in math education so difficult? The reason why I say that is because people have made some strides forward and productive inroads for gender. But for white women, in particular. And that whole experience of math being neutral or colorblind was once applied to math being gender-blind, and yet many women would still argue that it is very much a male dominated field with a sexist orientation given their experience. But we don't hear that as much any more. And sometimes I feel that folks that have been strong in their calls for gender equity in mathematics aren't necessarily doing the same in standing *with* folks when it comes to racial justice and equity in mathematics for historically marginalized groups. And I wonder about why that is happening?

Danny Martin:
Well it goes back to my first response. Math education is no different than the rest of society. We struggle in society to have productive conversations and get some movement and some traction on racial justice issues. So it is no surprise that we struggle in the field for a lot of the same reasons. Conceptually, there is a "white sensibility," but it is also about white benevolence, where sometimes people think that their benevolent efforts, individually and collectively, are enough to side step the conversation or overcome the conversation about race and the real results we need to address. Sometimes it is the clash of identities. For example, a white progressive who is interested in racial justice still has to unpack and understand their whiteness. That is difficult. They will need to probe and understand their own complicity in racial injustice even though they are fighting for racial justice.

Julia Aguirre:
So we talked about why is this still a struggle. And even with using other kinds of justice struggles in math education like gender, so what do you think has to happen for us to move forward and make substantive changes?

Danny Martin:
That is a really big question because I could approach it in several different ways. Let me try this one way, drawing on recent self-reflections about my work and my efforts. I am struggling with the idea of merely *being critical versus being radical.* Much of what I have been reading lately argues for radical agendas, moving beyond incremental approaches that capitulate within the current system. Authors in these texts talk about reimagining a new and different system, where the forms of oppression that we are fighting don't exist. On the surface it is sort of Utopian. But, I think it is important to at least engage in what Robin D.G. Kelley calls the *radical imagination – radical dreaming*. This is where I am struggling. As critical as we are, we are still in a system that wants to absorb us. Look at what happened as a result of my commentary at the NCTM Research Conference last year. Many of us are

starting to rethink and question such institutions. Their response is often to try to bring us into the fold. That is how systems and structures work to absorb the critical. We need to be thinking about new and different systems where we are not having the same conversations over and over again about the power of whiteness, white privilege, and racial hierarchy. In math education we talk about the socio-political turn, the critical moments that we are in, our critical scholarship. But much of this is contained and absorbed by the system. Or, if it gets too critical and borders on the radical then it is actively resisted by the system. But we got to keep that radical imagination alive.

Imagine if a group of us said, for example, "NCTM no longer." We are going to do something very different. And we are going to try to get those who are like-minded to do something different. Imagine what would happen! Or, can we imagine what would happen? There would be all kinds of movements and efforts to put us in our place and get us back in line so that we don't dismantle the prevailing structures. They would tell us that what we are proposing is either the wrong time, we should wait, or throw us some bones in the mean time: the incremental approach. This is the thing I'm struggling with. It is the issue for me that makes it harder for me to provide "answers" to what we should do because I know those answers are in the box – the box of the current structure. And my imagination is not as profound as it should be in terms of imagining what the new and different thing should be.

Julia Aguirre:
Right, the system that we are working in was inherently set up as a system of discrimination and yet is it so integral to our social system as we have it. How do you figure out ways to dismantle it and do it in a way with a sustainable replacement? There is a balance to achieve, right? At the same time there have always been voices of resistance and calls for change because it was not working. So being able to hold up that mirror and continue to say this is the reality is crucial. I think one of the things that I feel is different now than maybe even 15 or 20 years ago, one thing is sheer numbers. There are no longer pockets of non-white majority schools and districts. The majority of our nation's schools are non-white. The indictment is that the system can no longer sustain itself, even if it wants to, it cannot sustain itself. Otherwise, children are just not going to learn.

Danny Martin:
But, I think the challenge to your point though is that even with the power of demographics we don't want the new thing to be a reproduction of the old thing where now it is a shifting that you have a different group on top and everybody else is layered in the hierarchy. I think the imagination is that…

Julia Aguirre:
We destroy the hierarchy.

Danny Martin:
We destroy the hierarchy itself. If the next group is lifted up and will do the same thing, we are just going in circles. I think that will be the challenge in the real radical imagination is to get to a point where it is not the case that a new group is exerting power over others.

Julia Aguirre:
I guess for me what is so different is that the system itself can no longer sustain the sorting and ranking that it has because it will implode. But getting people to see that in relation to racial privilege and the power that has been afforded their families, that's really still a challenge to get folks to think about.

Danny Martin:
And what role we play as math educators. What role do we play in that sort of educative process? How do we work with pre-service teachers and practicing teachers, and to the degree we get into classroom spaces, students, to help them unpack the way our history has unfolded to accomplish what it has accomplished while still being faithful and having some fidelity to our concerns and interests in math education? How do we blend that together?

Julia Aguirre:
Well, we want children to learn mathematics. We want them to enjoy and see all those great things about the domain and also see it as social tools and the way it is being utilized to convey information, to convey misinformation. So having students to be able to develop that part of their understandings, no one is going to argue with that. But the way students get educated mathematically is up for grabs. The

perpetuation of curricular tracking, for example, where students are exposed to different kinds of math depending on the school they attend or the track they are placed in. Experiences with interesting mathematics are not available to everyone.

So, keeping with this view of a *radical imagination*, how will we know we are being successful? What would be indicators that things are changing or that we are now seeing a system that we would want to see? What would be our success indicators?

Danny Martin:
I am reading this book called Freedom Dreams by Robin D.G. Kelley that talks about the Black radical imagination. I don't know if he uses it as an indicator but he keeps going back, and this may sound a little corny or soft, but he keeps going back to mentioning of a world where we can *truly love* each other. There are a lot of things that go along with that: respect, empathy, and value. How do we truly get to this place where love is fundamental to our lives and so deep and profound and that we reject all those forms of oppression that we have been fighting against. Because a lot of what is happening is the other side of that. The violence. The violence of policy, the violence of going to school in particular kinds of settings, the violence of what we do to each other in terms of our discourse – the way we talk about children and each other. Why can't we do that in more loving ways? Why can't we talk about children in more loving ways rather than reducing them to their test scores? Or, talk about them in terms of other children being inferior or superior? The racial achievement gap, that is insulting. That is violence against our children. Why can't we develop policies that show that we truly care about the work of teaching and we care about the people who are doing that work? And, in fact, it is not just that we care about them, but that we have a deep and profound love for the fact that they love our children. I'm not going to give you a list of outcomes that we need to achieve, but in terms of the kind of world that I want – Love and respect and empathy, those things go a long way in shaping what we do.

Julia Aguirre:
What you are saying is really fundamental. I think people look for other kinds of indicators. They are not looking for fundamental humanizing, rather than dehumanizing, tools. To me when I think of those kinds of things, my head goes to Paolo Freire's work and the ideas of the role education has played to dehumanize or humanize and the role of literacy in that. And, it is so fundamental, yet for many people those three things: love, respect, and empathy in math education is just hard for folks to get their head around. That is a radical way of thinking if we are going to be successful what it would look like. That is fundamental and yet foreign to a lot of people.

Danny Martin:
That is a good way to put it, fundamental yet foreign. You know some people may quibble with foreign, but I get exactly what you are saying. And we know that these things are important. Why can't we base schooling on the love of children? Some students are treated as inhuman. Maybe their actions, getting back to this idea of commentary, maybe that violence that we hear on the news is really a commentary on how we have been treated by society. You have confined us to essentially caged neighborhoods with little resources. And the outburst of violence is not genetic or cultural, but a response. You are telling me you don't love me.

Julia Aguirre:
Right. And that goes to the idea of how is that structured and what are people's individual agency to counter that oppression? At the same time, people can make decisions that are different. It is a constant tension. All of this fundamentally goes back to issues of identity and how identity is formed through one's own storytelling and about how your identity is structured by social forces, many social forces.

So I am going to ask you the last question. What advice do you have for moving forward together on the path of social justice in mathematics education?

Danny Martin:
We have to be committed to being honest and saying and naming things for what they are. Not trying to side-skirt the issues. We have to understand that it is more important to be honest and name things than to placate and capitulate for the sake of maintaining our own individual positions. We have to continue to ask the hard questions about things we have taken for granted: assumptions, institutions, and kinds of scholarship. Although we do our work *in* math

education we have to be critical *of* math education. We also have to be critical about the social justice framing because justice and injustice are locked together. You cannot have one without the other. So to the degree that we argue, push, and move the justice portion forward, it is usually in relation to something that we consider unjust.

Julia Aguirre
So what I hear you saying is that one of things we need to do to move forward together is to maintain a critical eye and, as a collective, engage in the radical imagination and change that we need. And work collectively and hear the multiple voices and multiple perspectives that the communities we work with bring to the table. But part of that is us listening and making sure we convey these ideas (or the communities' experience and knowledge) in our work in teacher education and research. Then, moving forward together requires honesty and being able to say and name things rather than skirt around or worry that you will somehow offend people in power, you soften what you say so they can hear it but softening doesn't necessarily mean they are going to hear.

Danny Martin:
So now many of us are going to be in the position of people representing the current power structure saying to us, "Well, what should we do? What are the solutions?" And here is what I've learned from others more wise than me, there is sometimes a trap in that when people tell you to give them a solution because you give them three or four solutions, those become the goal posts that now people in power can avoid. They can quickly say, "Well, see that is not going to work. We can't do those three or four things for our students." Or "Those three or four things are too difficult" or "We tried to do those three or four things and it didn't work, let's just keep things the same." It is like the danger of reparations. Once given, given. They can just say, "We are done." In their view, they can wipe their hands of all the oppression.

Julia Aguirre:
Using the example of reparations. Even if you are to get reparations it doesn't erase the legacy of slavery. It is part of legal system. It is part of our penal system. It is part of our government system. Until you address those things, it is not going to change. And those are the things that are hardest.

Danny Martin:
The fundamental stuff as you said earlier. The systemic, fundamental stuff. Sociologist Joe Feagin says race and racism are foundational to this nation. People don't realize or accept that it is foundational. It is wrapped up in the very thing that we are. We can't just wipe it off or clean it off with a towel. It is embedded in everything that we do.

Julia Aguirre:
And I think for many math teacher educators, math education scholars and teachers of mathematics that idea in relationship to teaching mathematics it is just hard for people to make sense of.

Danny Martin:
That's our challenge.

Julia Aguirre:
I think the idea around learning to be honest and naming things and helping people understand that there are no easy solutions is key. You are talking about this radical imagination. This would mean that we would be living in a more just world, right? I can help kids learn math, math is not used as a tool of oppression. I can help kids learn how math is part of our communities and the different ways it's used in different parts of the world, and we are still fundamentally engaging that part of our humanity, our thinking.

Danny Martin:
I think what is interesting, and you have said it several times now and I like this idea, and I know I've read about it, this idea of humanizing mathematics and mathematics education. I'm starting to wonder why we haven't we been more explicit about that. We have these big umbrella terms. We have equity and diversity. But humanizing has a different tone to it: Social justice versus humanizing. If I had to choose, moving forward, it would be this humanizing piece. I want my three-year-old to live in a world where he embraces and understands the humanity of other people and he understands his own humanity and he understands the threats to his humanity. So I think social justice and equity will come along with emphasizing humanity.

That's Not Fair and Why: Developing Social Justice Mathematics Activists in Pre-K

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Abstract

Prekindergarten mathematics can be filled with rich, complex mathematical talk that moves beyond traditional counting and cardinality. When paired with issues of fairness, mathematics becomes a social justice tool that empowers prekindergarteners to mathematically recognize and address oppression they see in their own world. We profile the critical mathematics details in two Black history-based activities in which children use mathematics to describe and confront the unfairness they notice within Rosa Parks and Harriet Tubman skits. Through these activities, children learn how to communicate and address the unfairness they see using mathematics. We also share instructional considerations and extensions for implementing these activities in the classroom.

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That's Not Fair and Why: Developing Social Justice Mathematics Activists in Pre-K

Theodore Chao and DeAndrea Jones

Today the classroom is a bus. Chairs are arranged in four rows of six seats, three seats on the left, three seats on the right. A large gap exists between the front two rows and the back two rows. A group of 20 children huddle in a group on the rug, just outside the entrance of the bus. Their formerly gentle prekindergarten teacher wears a bus driver outfit complete with bus driver cap and sits menacingly in a chair at the front of the bus, arms and back hunched over a pretend steering wheel.

One by one the children enter the bus and put a coin into a small metal bank. The bus driver looks each child up and down, sizing each up before barking, "Good morning. Please go to the back of the bus." One by one, each child hurries to the back of the bus and sits down in one of the back two rows.

After the twelfth child boards the bus, the back two rows are filled. As the bus driver growls, "Please go to the back of the bus", the thirteenth child looks to see that no seats are available in the back and timidly takes a seat in the second row of the bus, the furthest-back row in the front section. The bus driver turns around, staring down the child, "You can't sit there. Move to the back of the bus." The child stands up, walks to the back of the bus, and awkwardly stands in the narrow row between the back two rows of seats. As the rest of the children board the bus, they fill in this standing area, each child looking at the rows of empty seats in front of them as the bus driver angrily drives through the make-believe town.

After a few minutes, the bus driver removes her cap and suddenly, the prekindergarten teacher is back. "How does this feel?" she asks, "Is this fair?" Children raise their hands to share about how this bus ride is scary, how it is not fair that there are so many empty seats. One child states that because he gave the bus driver a coin, he should be able to sit down. Another child observes, "There are twelve empty seats. And eight of us do not have seats." Another child shouts, "Yes, we can all sit down and it would be fair!"

The prekindergarten teacher asks for a volunteer who can be really, really brave–someone who can put on a big, brave face. One girl timidly stands up to volunteer. The teacher asks the girl to get on the bus again, and this time, to be brave and sit in the front of the bus. The girl is Rosa Parks.

The prekindergarten teacher puts on her hat and disappears; the angry bus driver emerges again. The bus stops. Rosa Parks puts her coin into the slot and gets on the bus. Once again, the bus driver looks the girl up and down, growling, "Good morning. Please go to the back of the bus." This time, the girl takes a seat in the front row. "You can't sit there," the bus driver says. The girl doesn't budge. The bus comes to a halt. The bus driver rises up, walks to the girl and says, "You can't sit there. Move to the back of the bus."

"No," says the girl. The rest of the children giggle.

"Move to the back of the bus!" shouts the bus driver. Somehow the bus driver has grown bigger, a giant of an adult hulking over this brave, small child.

"No," says the girl. The children giggle again.

"Let's go, I'm taking you to the back of the bus," says the bus driver, grabbing the girl and pulling her to the back.

"No," says the girl, clinging onto her seat and refusing to budge.

Exasperated, the bus driver returns to the front of the bus and pulls out a radio. "We've got a situation here." The bus driver turns off the bus, stands up, and walks out.

The Montgomery Bus Boycott has begun.

Social Justice in Mathematics Education

Much of the early work in teaching mathematics for social justice evolved from lessons on activism from the Civil Rights era. For instance, the Algebra Project work from the 1980's emphasized how enrolling in Algebra in the 8th-grade was a civil right denied to countless Black students to keep them out of college matriculation (Moses & Cobb, 2001). Likewise, work in the 1990's focused on

empowering mathematics learners to recognize and resist oppressive and racist norms, such as helping Black families fight back against tracking their students into remedial mathematics classes or learning to see the racist implications of seemingly neutral statistics reported in mainstream media sources (Frankenstein, 1992, 1994; Martin, 2000). Teaching mathematics for social justice also connected to global movements, notably Paulo Freire's (1970) work with Brazilian literacy educators detailing how critical education builds *conscientização*, a critical consciousness in students and teachers (Gutstein, 2006). This idea of using mathematics as a means to help children read and write the world through real world examples of oppression is prevalent in the popular social justice mathematics resource *Rethinking Mathematics: Teaching Social Justice by the Numbers,* edited by Gutstein and Peterson (2013), a book of lessons, activities, and commentary focused on upper-elementary through secondary teaching.

These examples show how social justice-oriented mathematics lessons can connect to secondary curriculum. But what about early childhood mathematics? How do teachers develop early numeracy concepts that connect to children's lived experiences? How do teachers introduce complex, real-world situations of oppression in age-appropriate ways that will not terrify young children? Working with young children requires a shift in focusing not only on mathematical concepts and appropriate representations of real-world situations, but also understanding children's identities and prior knowledge. We refer to a children's mathematics identities as the dispositions and beliefs children develops around their ability to participate and perform in mathematics (Aguirre, Mayfield-Ingram, & Martin, 2013, p. 14). Recent scholarship on teaching elementary mathematics for social justice reveals the importance of helping children develop identities in which they powerfully use mathematics in their lives (Aguirre & del Rosario Zavala, 2013; Aguirre et al., 2013). Mathematics teaching for social justice also involves the development of *critical mathematics agency*, in which children learn to view their world with a critical mindset and imagine how to make their world a better and more equitable place (Tan, Barton, Turner, & Gutiérrez, 2012; Turner, 2003).

At the elementary and early childhood level, mathematics teaching for social justice must also connect formalized mathematics to the complex and sophisticated mathematics already present in children's histories and communities (Civil, 2007, 2009; Turner, Gutiérrez, Simic-Muller, & Díez-Palomar, 2009). Finally, mathematics for young children must involve play in order to open up opportunities for non-routine problem solving, practicing perseverance, and connecting mathematical ideas (Parks, 2015; Wager, 2013). Therefore, we situate social justice mathematics at the prekindergarten level as developing powerful mathematical identities, developing critical mathematics agency, honoring and connecting to children's family and cultural histories, and centered around play.

Our Context

DeAndrea has been teaching prekindergarten for almost 15 years. She teaches in a Pre-K through 5th-grade elementary school that serves a historically Black population in a low-income, city environment. DeAndrea engages her children in activities and skits every day, helping them articulate their emotions, resolve conflicts with one another, and appreciate the joy of creating, whether composing songs, cooking lunch, or building graphs to document how they feel. DeAndrea views her teaching as helping her children build "Thrive-al" skills: activist skills that help them survive, thrive, and potentially transform the world around them. Thriv-al skills involve recognizing the oppression of racism and poverty permeating their communities along with developing confidence to fight this oppression. Additionally, DeAndrea wants her children to always laugh and find joy in their world.

In this article, DeAndrea, pre-K teacher of mathematics, and Theodore, a critical elementary mathematics teacher educator, detail how we expanded upon two of DeAndrea's activities so that the mathematics instruction connected authentically to social justice. Both activities came from a self-created unit on classroom diversity with roots in literacy that DeAndrea developed over her career to integrate Black history into her teaching. We augmented these activities for children to understand the complexity of Black history through literacy and

role-play, as well as how to use mathematics to develop these Thrive-al skills.

Rosa Parks and the Montgomery Bus Boycott

The Rosa Parks and the Montgomery Bus Boycott activity described earlier introduces children to the context surrounding a key moment of civil disobedience in the Civil Rights struggle. DeAndrea enacted this activity for years as part of a diversity and Black History unit, which emphasized recognizing modern racism and developing activist dispositions.

We noticed a wealth of resources in this activity to connect to children's sophisticated mathematical thinking. First, the simplest mathematical aspects for young children was in counting the number of empty seats, counting the number of children who did not have a seat, and comparing these numbers. We noticed that all the children knew something was not right in how certain students had seats while others did not (i.e., "That's not fair!"). All the children were able to count that eight children were standing up in the bus without a seat. Most children were able to count that the bus had twelve empty seats in the two front rows (i.e., "*There are twelve empty seats"*). And some children were able to articulate how the situation was not fair because eight children did not have seats, yet there were more than enough seats for every child (i.e., "Yes, we can all sit down and it would be fair!"). When children discussed their mathematical observations, they displayed evidence of counting, one-to-one correspondence, and comparison of two distinct amounts. These explanations showed mathematically sophisticated reasoning, particularly for three and four-year old children (Clements & Sarama, 2007; Wager, 2013). This sophistication is a result of young children challenged to use mathematics to describe the unfairness of a situation they were role-playing, a situation empowering their voice to describe the racism they already felt in their own worlds.

Extensions and Connections

Our example activity is designed for a prekindergarten classroom. One way to introduce the activity is through interior drawings of the bus in which students count and add up the seats, documenting the number of filled and empty seats in various situations. Another extension involves counting the amount of money each bus ride costs. Making each bus ride costs 10 cents is a simple way to incorporate base-ten fluency and 1-to-1 correspondence between coins and people on the bus. Children can generate strategies to figure out how much money the bus collected from all the riders in the class. To use this same activity for older children, we recommend expanding the activity to incorporate larger numbers (that are historically accurate) and the concepts of money and time. Possible extension questions include: 1) If it costs 10 cents to ride the bus, how much money did our bus lose when all the Black people stopped riding the bus? 2) If 40,000 of the daily Montgomery bus riders are Black, how much money did the Montgomery Bus system lose every day of the boycott? 3) The Montgomery Bus boycott lasted 381 days, how much did the system lose during the entire boycott?

Additionally, the activity could incorporate more historical accuracy, such as arranging the classroom bus to look exactly like the bus that Rosa Parks boarded, having the boycott occur when Rosa Parks refuses to go to the back of the bus when a white man boards the bus (as opposed to when she first boards the bus), and discussing the role of teenager Claudette Colvin in the civil rights struggle ("Before Rosa Parks, A Teenager Defied Segregation On An Alabama Bus," 2015). Colvin was a teenage NAACP member arrested for not giving up her seat on a bus nine months earlier, but her arrest was ignored by NAACP leadership because they felt that as a defiant, dark-skinned teenager without civil rights training, the general public might not rally behind her (Hoose, 2009). Studying how Claudette Colvin, a brave student-activist inspired by Harriet Tubman, fought back against the racist bus segregation practices before Rosa Parks, helps children see how they can also enact thrive-al skills when they see something wrong in their own lives.

When doing this activity in your own classroom, remember that even though the bus driver is acting scary, the children should never be truly frightened. Remind your children this is make-believe and keep the skit silly so that children are giggling, laughing, and having fun. Additionally, resist taking control of the discussion that happens when the bus boycott

begins. Children have fascinating questions or points to make. Listen to what the children say and follow their lead. Also, incorporate costumes and allow children to dress up or make their own costumes. Having a realistic bus driver uniform and allowing children to wear period costumes adds to the authenticity of the skit. Finally, incorporate picture books into the lesson, such as *Rosa* (2007) by Nikki Giovanni and Bryan Collier and *If a Bus Could Talk* (2009) by Faith Ringgold.

In order to connect the historical events from this activity to modern racism and oppression, allow conversations to materialize naturally about how children feel on the bus. DeAndrea's children often notice how friends on the bus are not allowed to sit next to each other if their skin color is different. This leads to discussions about other places in their lives in which they feel they or a loved one are not allowed to do certain things because of skin color. It also allows children a template to reflect upon when they encounter racism in their future. Again, our experience has shown us that it is not necessary to push on these questions, as children will come up with these observations on their own.

Harriet Tubman and the Underground Railroad

Another activity DeAndrea honed through the years explores Harriet Tubman and the Underground Railroad. In this activity, children learn about Harriet Tubman and how the Underground Railroad helped escaping slaves travel north to freedom. DeAndrea introduces songs used by the Underground Railroad to help escaping slaves navigate and evade danger. Students discuss the history of slavery in the United States of America, how it might feel to be owned by someone else, the fairness of slavery based on the color of one's skin, and how slaves escaped to freedom. Through this activity, children experience the importance of music, coded speaking, and strategy sharing, particularly within the Black experience. The skit follows the song, *Follow the Drinking Gourd* (Texas Folklore Society, 1928), which on the surface refers to a hollowed-out gourd used for drinking, but is actually code for the Big Dipper constellation that points North.

For this skit, divide the classroom into four sections. In each section, a different child plays Harriet Tubman, who must clandestinely lead the rest of the class through a pathway of escape (e.g. under tables, behind bookshelves, through tunnels) to freedom. Harriet Tubman draws a visual map to devise a pathway to freedom and notes the dangers surrounding that pathway. Since the other children will not have access to the visual map, Harriet Tubman then uses mathematical language, spatial thinking, and measurement to construct a verbal description of the pathway, making sure to emphasize order, sequencing, and precision. For example, Harriet Tubman might say, "First, take five steps to the circular table. Second, crawl under the table. Third, as you get out, stay to the right side and creep along the wall for ten steps. Fourth, slip behind the rectangular file cabinet." Harriet Tubman must field test these directions first, noting the importance of making sure the directions are accurate and detailed. Remember, an inaccurate map results in friends being re-captured into slavery. Children then convert these steps into a structured song, creating verses for each step. For example, the children restructured a song such as "Heads, Shoulders, Knees, and Toes" to "Step, Crawl, Creep, and Slip" to match Harriet Tubman's direction. The songs use coded terms that children understand but "adults", in the roles of slave catchers, would not. Children then sing this song as they navigate the path to freedom.

Through this activity, children create sophisticated mathematical songs using coded language to describe these sequenced pathways to freedom. Children use mathematics to engage with and find power within a historically oppressive situation. This lesson also allows children to develop critical mathematics agency (Tan et al., 2012; Turner, 2003), in which their maps and songs are mathematically accurate and creative while still deliberately disguising the path to freedom. Children learn how to use mathematics to create a tool of resistance and liberation in fighting against the brutal system of slavery.

Extensions and Connections

An extension for older children would be to connect to Freedom Quilts, quilt patterns used to signal directions along the Underground Railroad. Neumann's (2005) *Freedom Quilts: Mathematics of*

the Underground Railroad article is a good resource for an activity in which children devise quilt patterns to represent specific parts of the pathway to freedom. Another way to make this lesson more historically accurate would be to include actual maps of the Underground Railroad (for teacher resources, see Houghton Mifflin Company, 2004; Scholastic, 2016). Extension questions to ask include: 1) How can you use non-standard units and coded language to describe parts of the pathway that slave-catchers would not understand? 2) What are different ways that you can measure aspects of your pathway? What units can you use? 3) What are ways you can use mathematics and coded language in your own world to deliberately hide something in plain sight?

When doing this activity in your own classroom, remember to emphasize the fun of song creation, which helps children connect the step-by-step pathway to music, rhythm, and cadence. This skit works well when older children are invited to participate either as role-play participants or helpers so that they either try to interpret the songs or are the "slave catchers" who should not understand the songs. Emphasize measurement with non-standard and standard units, helping students see that non-standard units make the pathways harder to understand for some people but easier for other people. For historical accuracy, emphasize the pathways follow a south to north progression. Finally, incorporate picture books into the lesson, such as *Moses: When Harriet Tubman Led Her People to Freedom* (2008) by Carole Boston Weatherford and Kadir Nelson, *Follow the Drinking Gourd* (2014) by Jeannette Winter, *Aunt Harriet's Underground Railroad in the Sky* (1995) by Faith Ringgold, *Sweet Clara and the Freedom Quilt* (2008) by Deborah Hopkinson, *The Patchwork Path: A Quilt Map to Freedom* (2005) by Bettye Stroud and Erin Susanne Bennett, and *Henry's Freedom Box: A True Story from the Underground Railroad* (2007) by Ellen Levin and Kadir Nelson.

Enacting Social Justice Mathematics Activities in your Prekindergarten Classroom

We hope our enactment of social justice-oriented mathematics in these two prekindergarten activities illuminates ways you can do this work in your own teaching. We end with tips we have learned from doing this work. First, always let the children lead the activity, particularly the discussion. Much of mathematics teaching is listening to children's thinking, so allow the children's questions and thoughts to drive the discussion. Second, remember to keep the activities fun and silly. For young children, play provides children with genuine opportunities to engage in mathematical thinking (Parks, 2015; Wager, 2013). Skits, songs, and creativity are also crucial for allowing young children to feel safe when engaged in scary topics such as slavery and segregation. When a skit involves a potentially terrifying situation or character, such as the bus driver from the Rosa Parks skit, emphasize that this is a make-believe situation. Third, involve older children in the activities. All children will benefit from working with each other, and the older children get to play specific roles in the skits and add insight or guidance. Finally, in terms of emphasizing the mathematical component of each activity, focus on children's conception of fairness and how they can use mathematics to explain why a situation is unfair. Start discussions by asking children whether they think a situation is fair and why or why not. Fourth, open dialogue about skin color and different cultures is a major norm in DeAndrea's classroom. This openness to talking about diversity and culture is a pre-requisite to conversations about unfairness and social justice in a prekindergarten classroom. This allows us to connect these skits to discussions about how children see and experience racism in their own worlds and how to use mathematics as part of their thrive-al skills to point out and actively resist injustice.

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Developing Sociopolitical Consciousness through Lorraine Hansberry's *A Raisin in the Sun*: An Interdisciplinary Project

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Abstract

This article describes an interdisciplinary project that combined the subject matters of mathematics and English/language arts while adapting the storyline of *A Raisin in the Sun* (Hansberry, 1984). The key teaching objectives, in this project, were to progress students toward mastery of linear and exponential functions, show them a connection between literacy and mathematics, and educate them on the struggles of Black Americans. We position the mathematics portion of the project within a fitting framework for social justice teaching, discuss its emergence and implementation, and offer teacher and student reflections for future replication and refinement.

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Developing Sociopolitical Consciousness through Lorraine Hansberry's *A Raisin in the Sun*: An Interdisciplinary Project

Celethia Keith McNeil and Christopher Fairley, Jr.

Mathematics may be used as an analytical tool to study injustices in order to persuade individuals to see other points of view as well as realize their own position (Gutstein, 2006). Teachers for social justice pose questions to students about relevant issues to analyze the society around them, while students learn to understand, formulate, and address their own questions to better understand conditions in their lives and the sociopolitical subtleties in the world (e.g., Gutiérrez, 2013; Gutstein, 2003, 2006; Leonard, 2008; Leonard, Napp, & Adeleke, 2009; Tate, 1995). Instead of teaching problem solving techniques, teachers can support a more liberating practice by implementing a problem-posing pedagogy (Freire, 2000). This bottom-up approach to teaching affords students the opportunity to not be passive recipients but active agents in their learning.

In this paper, we describe how the classic play, *A Raisin in the Sun* (Hansberry, 1984), was used as the context for an interdisciplinary mathematics and language arts project to expose notable injustices toward people of color, specifically Black Americans. Adapting Gutstein's (2006) framework of teaching mathematics for social justice, we describe the components of the project, align the project to the social justice framework, and discuss the goals and outcomes of the project through teacher and student reflections.

A Social Justice Framework for Teaching Mathematics

According to Gutstein (2006), there are two overarching aims for teachers who want to use social justice pedagogy: (a) to develop a political awareness within learners to help them realize their position in society and history, and (b) to motivate individuals to action. Gutstein developed a social justice framework to teach mathematics with two sets of pedagogical goals, one set on social justice and the other set on mathematics. Here we focus on the latter set of goals related to mathematics and later discuss how Mr. Ferguson's project aligns with each of these goals. In particular, the mathematics' pedagogical goals we will focus on are: (a) reading the world with mathematics, (b) writing the world with mathematics, and (c) developing positive cultural and social identities (Gutstein, 2006).

First, *reading the world with mathematics* may be interpreted as the understanding of the cultural, historical, and sociopolitical conditions in one's life. This goal describes the use of mathematics to identify and analyze power relations, inequitable resource allocations, and unequal opportunities among social groups to comprehend blatant discrimination as it relates to societal differences (Gutstein, 2003). Moreover, it means to mathematize phenomena in one's life locally and globally while making connections between them. Second, *writing the world with mathematics* is changing the world through the use of mathematics. It is a developmental process where individuals begin to view themselves as people who can take action and make change. Third, *developing positive cultural and social identities* stands on the premise that students sacrifice constructs they value such as culture, language, and community in order to thrive in the dominant culture, despite deep roots in these constructs. Students are culturally competent when they are able to maintain personal cultural integrity while being academically successful (Cooper, Denner, & Lopez, 1999; Ladson-Billings, 1995). Through a sociopolitical perspective, educators and/or learners may be challenged with how they describe themselves, as new experiences influence their views and perceptions. Teachers may play the role as "identity workers" by recognizing when a student is not doing what is expected in the classroom and, in turn, taking action to support them (Gutiérrez, 2013). When students feel inferior, inadequate, or do not have a sense of belonging in the local culture, understanding teachers are empathetic

and discover ways to support students through their negotiation in the classroom.

We have described Gutstein's (2006) framework to situate the work of Mr. Ferguson, a high school mathematics teacher, as a social justice mathematics project. Next we will set the stage for and discuss the implementation of the project.

The Interdisciplinary Project: Its Emergence and Implementation

Mr. Ferguson teaches in a southern rural town at an early college high school. Since his arrival, there have been attempts at 'interdisciplinary' projects to incorporate social justice (e.g., the Model United Nations debate). Although effective in its own right as a speech and debate competition to discuss social justice related issues, there was no real evidence of mathematics application. Subsequently, Mr. Ferguson decided to create his own interdisciplinary project for his Math 1 course[1] in order to motivate students and expose them to the historical realities of people of color.

Mr. Ferguson, a novice teacher at the time of the project's implementation, collaborated with a language arts teacher at his school to make mathematics more interesting for their mutual students. Mr. Ferguson expressed his thoughts about linking social justice with mathematics: "This is something that I've been wanting to bring into mathematics class since I started teaching, because these kids don't know… Hopefully it'll open some eyes." When asked to elaborate on what he meant by the kids not knowing, he replied, "I gave a Black history trivia quiz in class two weeks ago, and the Black kids were clueless…they are not aware of all the contributors, inventors, activists, and leaders that helped form this nation. Some thought the Underground Railroad was an actual railroad!" Realizing the lack of knowledge his Black students had about their history, Mr. Ferguson, a Black male, seized the opportunity to be innovative in his teaching approach to help all of his students become more aware and critically conscious. Hence the interdisciplinary project *A Raisin in the Sun* was developed.

A Raisin in the Sun is about a poor Black family in 1950s Chicago. The father of the family just died, and the story begins with the family awaiting the insurance check in the mail. Each of the family members expressed their dreams on how they would like to spend the money. Mr. Ferguson had three key motives for choosing *A Raisin in the Sun*. First, he wanted to challenge himself to create an interdisciplinary unit with English/ Language Arts 1 since this course and Math 1, are courses where freshman students tend to struggle the most. Many students experience limited success with mathematics, reading comprehension and grammar in middle school and have difficulty with the higher expectations of the high school's early college environment. Second, Mr. Ferguson was familiar with the play and knew it would be a great opportunity to integrate the Black experience with mathematics applications. Moreover, Mr. Ferguson, an activist, believes that school textbooks will never tell the whole story and wanted to reveal an untold story to his students. Lastly, Mr. Ferguson wanted the students to understand the importance of identity, Black history, and the way students of color value themselves.

The implementation of this project was intended to achieve the following goals: (a) progress students toward mastery of linear and exponential functions, (b) show students a connection between literacy and mathematics, (c) educate students on the civil rights struggle of Black Americans, (d) use technology for research, application, and presentation, (e) allow students to reflect on their own career goals and the cost to achieve them, and (f) integrate Fine Arts in the classroom. All of Mr. Ferguson's Math 1 students were repeating the course for the first or second time. Subsequently, he decided to implement this project as a more innovative approach to teaching mathematics. There were 25 students altogether, 16 in the first block and nine in the second block. For the first block, there were four males and twelve females: 4 Black, 4 White, 6 Hispanic, and 2 Native American. The

[1] Math 1 is part one of an integrated mathematics sequence replacing the traditional, more focused Algebra 1 course.

second block was all female: 5 Black, 1 White, 2 Hispanic, and 1 Native American.

The entire project took approximately two weeks of 90-minute class blocks; instructional days in this two-week window typically consisted of 30 minutes of lecture followed by 60 minutes of independent and/or collaborative work. For scaffolding purposes, the project included four parts: (a) graphing a symbol from the story, (b) "Ten Years from Now" goal setting activity, (c) recommendation report, and (d) presentation. We describe each part below in more detail.

Part I: Graphing a Symbol from the Story

The mathematics in this project includes modeling with linear and exponential functions, solving multi-step problems, appropriately choosing and interpreting units, rates of change, and growth and decay. Mr. Ferguson created groups of three to four where each student chose a character upon which to research and reflect (see Appendix A). Each group represented the main characters of the Younger family (i.e., Mama, Bennie, Ruth, and, in some cases, Walter). The purpose of this grouping was to compare and contrast the characters' hardships in the 1950s to those of their own. In Mr. Ferguson's first block, the female students were able to choose any female character to analyze during the project; all males played the role of Walter by default. Students chose the character they related to the most after reading the book in Language Arts 1 class. In the second block of all females, Mr. Ferguson slightly altered the story where they had to experience raising a family without a male figure in the household.

Once the students read and summarized the play's plot, they identified different symbols from the story. Students drew and analyzed the most significant symbol on graph paper (see Figure 1). The students wrote equations for eight lines within the symbol: two horizontal lines, two vertical lines, and two positively sloped lines, and two negatively sloped lines. The work below illustrates the house Mama bought as one student's significant symbol in the play, and an equation for one of the lines within the symbol.

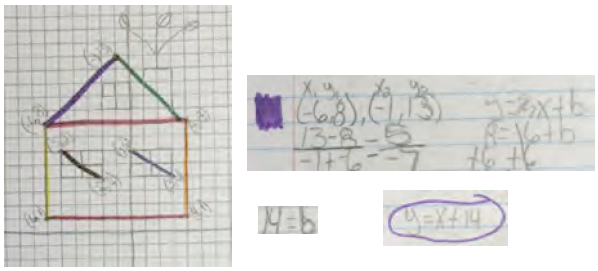

Figure 1. Student's graphed symbol and work to find slope for part of the roof.

Although symbolism relates more to the language arts portion of the project, Mr. Ferguson saw this as an opportunity to incorporate mathematics through graphing and writing equations of lines within the symbol that was significant and meaningful to the student.

Part II. Ten Years from Now

For the second part of the project, students were asked to think about their future and write down goals they hope to achieve within 10 years (see Appendix B). The students compared their aspirations to those of the Younger family. Once students had time to externalize their life goals, they were instructed to "do the math" for the Youngers' dreams before preparing a recommendation report. While considering the Youngers' dreams and obstacles of poverty, racism, and sexism, the students had to use mathematics skills (i.e., linear and exponential growth models) to make sense of different scenarios in *A Raisin in the Sun*. The following are some examples of mathematical and literary analyses investigated by students.

Each member of the Younger family came with his or her own set of problems to solve, and students conducted research to determine their respective character's salary. Taking the character of Mama for instance, students had to find the salary for a seamstress in the 1950s considering her location and race. They determined whether Mama would be able to cover the monthly mortgage payments by herself, or if she needed help from the family. Other factors also considered were how to distribute income using the linear growth model such as expenses for transportation, groceries, and clothes.

In the play, the Younger family lived in a cramped apartment and Mama used some of the insurance money with a bank loan to cover the down payment for a house. The rest of the money was divided between her children, for their dreams. It was Mama's dream to own a house. Mr. Ferguson's students had to think about the policies of the lending institutions of the time that advantaged whites and discriminated against Blacks. His students discovered that Mama had a very high interest rate. While considering this obstacle, students calculated the total interest after 30 years, added it to the cost of the house, and determined the monthly payment of the house using the exponential growth model. Through this model, students learned that the price for Mama's house almost doubles over time because of the high interest rate. Students expressed their opinions in classroom conversations and written reflections.

Part III. Recommendation Report

Toward the end of the project, students wrote a recommendation report to the Younger family with a convincing mathematically-based argument for whose dreams should be financed (see Appendix C). There were five key components of the report: (a) overview expressing the need for the recommendation report and financial concerns of the family, (b) cost of dreams, (c) income of each family member, (d) conclusion, and (e) recommendation.

The overview of the recommendation report explained the purpose and financial needs of the family, which did not include the cost of dreams. Next, the students outlined the cost of the dreams for all family members explaining why particular costs were included. The students constructed a table organizing the costs of each character's dreams. Students then explained why the incomes of all family members should be considered, and constructed a table showing this information. Mr. Ferguson modeled how to set up the tables and other parts of the project. The final section of the report included an informed recommendation for what the Younger family should finance with the accompanying budget justifications and explanations of how the students decided to prioritize the family finances.

Part IV. Presentation

Each student received an individual and group grade based on a presentation rubric. As part of their group presentations, each group had to introduce their character, explain the motivation for their dreams, and make evident their dreams and obstacles. The students had to present in front of the class as a group with slides using a presentation tool. During the end-of-course reflections, some students mentioned that this project helped with speaking in front of others, making sense of the mathematics, and constructing convincing arguments.

Framing the Project in Social Justice

As discussed earlier, Gutstein (2006) identified three mathematics-related pedagogical goals in his social justice framework: (a) to read the world with mathematics, (b) to write the world with mathematics, and (c) to develop positive cultural and social identities. Here we situate the mathematics portion of Mr. Ferguson's project within the framework to categorize it as an instance of social justice mathematics pedagogy.

Goal 1: Reading the World with Mathematics

Mr. Ferguson's students analyzed the characters in the play to understand their struggles with race, gender, and class. Further, all points of view of the story were carried out within each group to understand the family as a collective unit. Mr. Ferguson wanted to expose *all* students—not just students of color—to life in the 1950s for Black people. During the project, students were able to mathematize the characters' dreams while considering the social injustices of the time era. All students confirmed in their presentations that the project was an "eye-opening" experience. Not only did they use mathematics to discover injustices, they also became aware of the cost of their own dreams and aspirations. Mr. Ferguson's students were able to critique the different components of the play and make connections to their own lives.

Goal 2: Writing the World with Mathematics

Mr. Ferguson's students wrote a persuasive data-based letter to convince the Younger family whose dream should be pursued with the insurance money (see Appendix C).

Character	Amount needed to financed and reason	Interest Rate for the money	Total amount paid over how many years and at what cost per month?
Lena Younger	$23,500	5%	Monthly: $282.13 30 Years: $101,565.64

Table 1 A portion of the Cost of Dream Table in Appendix C

From the Cost of Dreams section in Appendix C, Table 1 above illustrates the cost of Mama's dream (to buy a house), the interest rate, monthly payments, and the total amount paid and the duration of time it would take to pay off the house. All of the Younger family's dreams are illustrated in this manner as a way to compare all of their dreams so that the students can decide whose dream is worth pursuing in the recommendation report. In their end-of-year reflections, some students discussed how this project resonated with them as they learned the power of mathematics through the lens of the play. One student reflected, "First, it helps me understand the life of Africans American during the 1950s. Secondly, it showed how to easily know how much I'm going to spend for financial needs by making a formula and solving it. And above all, the project was useful to me because I developed my math skills." This opportunity to reflect gave students time to ask questions about why they were learning some concepts over others, who benefitted from learning it, and how identities were constructed as a result. The mathematics concepts that took priority in this project were discussed in Part 1 above. Students may be viewed as change agents in their learning through the lens of the characters in the play; they realized the power relations, unequal opportunities, and discrimination (Gutstein, 2003). They were also made aware of some parallels in current society, which makes these issues more relevant to them.

Goal 3: Developing Positive Cultural and Social Identities

As positive cultural and social identities develop, individuals relax their culture to better cope within the dominant culture by negotiating their culture with or enculturating to the dominant one (Gutstein, 2006). As mentioned earlier, the students completed an assignment addressing where they see themselves in 10 years (see Appendix B). Similar to the Younger family, the students were denied their civil rights and their desires from the 'Ten Years from Now' assignment to simulate their dreams being deferred as they position themselves in the play and become empathetic with the characters. For example, if there is something that the students addressed in their 'Ten Years from Now' assignment that was not allowed in the 1950s, Mr. Ferguson explained how they would be restricted from doing certain activities or achieving goals that they had. They also discussed racially charged current events and compared themto the play. One particular event that was a hot topic at the time of this project's implementation was the 2014 riot that took place in Ferguson, Missouri where a young Black adolescent Michael Brown was shot by a White police officer. Although this affected students of color more, Mr. Ferguson found it imperative to discuss with all students regardless of race. Some students talked about how the events affected them and some had personal experiences to share about racism. Comparing the dreams of the characters to those expressed in the 'Ten Years from Now' assignment put things into perspective for the students helping them to understand how their lives were similar to the characters in the play.

In their reflections, some students were overwhelmed with the issues learned in the story, but they appeared to have enjoyed the learning experience. One student stated, "I learned how to invest money in financial need and…discrimination…[,] when to spend, how to spend, and how much money to invest." In light of this project, students realized their career goals and how powerful mathematics was in their goal setting and understanding the world around them. Students commented on the excitement they had with participating in different projects and interactive activities. When asked what stood out in the class and why it was important, one student responded, "Learning math matters because numbers are in just about everything such as…business, photography, money…I need to know banking and finance so I would be able to keep my own business financially

stable…photography is all about angles, which involves numbers and degrees." This student later expressed that we all should value the privilege of education, because everyone does not get the opportunity.

Conclusion

This interdisciplinary project was an attempt to bring forth a "differential consciousness" which decomposes one's self and sparks contradiction in beliefs by a new awareness, as we are constantly creating ourselves in history (Gutiérrez, 2013). Students are not typically being afforded the opportunity to construct themselves within the mathematics they are taught, as teachers have to rush to move through many mathematics concepts for them to be ready for mandated standardized tests. Students need to be able to make connections across the curriculum and real life. Otherwise, they may form ideologies that block them from being able to contextualize or apply mathematics to realistic situations and continue to ask the ubiquitousquestion "When are we ever going to use this?"

Mr. Ferguson was pleased with the outcome of the project. However, he felt that he could have given more tailored feedback as opposed to whole group discussion. It was his hope that his students got a "reality check," and that they would share this experience with their families and peers. Further, Mr. Ferguson received positive feedback from fellow staff members and current students, while some of his former students were disappointed that they did not get this opportunity to do the project.

Teachers should try providing students with a more holistic approach to learning about the world around them and the interplay among subjects through interdisciplinary projects (Scheer, Noweski, & Meinol, 2012). This project steps away from traditional assessment and assignments for the sake of the mandated tests and gives students time to reflect and evaluate their developing identities through a mathematical and social justice lens. By positioning themselves in a different culture and historical era, investigating individual's dreams and systemic obstacles such as institutional racism, and making connections to their current lives and future dreams these students are developing a critical consciousness—seeing that mathematics matters and can play an important role in their lives and the struggle for social justice and equity.

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Appendix A

Part I. Character Overview and Graphing a Symbol from *A Raisin in the Sun*

Math I Standards:

CCSS.MATH.CONTENT.HSN.Q.A.1
Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

CCSS.MATH.CONTENT.HSF.LE.A.1
Distinguish between situations that can be modeled with linear functions and with exponential functions.

CCSS.MATH.CONTENT.HSF.LE.A.1.A
Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

CCSS.MATH.CONTENT.HSF.LE.A.1.B
Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

CCSS.MATH.CONTENT.HSF.LE.A.1.C
Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Purpose: Students will build competency in the above standards through analysis of the lives of the following characters from the award-winning theatrical *A Raisin in the Sun*:

1. **Lena Younger ("Mama") -** Walter and Beneatha's mother. The matriarch of the family, Mama, is religious, moral, and maternal. She wants to use her husband's insurance money as a down payment on a house with a backyard to fulfill her dream for her family to move up in the world.
2. **Beneatha Younger ("Bennie") -** Mama's daughter and Walter's sister. Beneatha is an intellectual. Twenty years old, she attends college and is better educated than the rest of the Younger family. Some of her personal beliefs and views have distanced her from conservative Mama. She dreams of being a doctor and struggles to determine her identity as a well-educated Black woman.
3. **Ruth Younger -** Walter's wife and Travis's mother. Ruth takes care of the Youngers' small apartment. Her marriage to Walter has problems, but she hopes to rekindle their love. She is about thirty, but her weariness makes her seem older. Constantly fighting poverty and domestic troubles, she continues to be an emotionally strong woman. Her almost pessimistic pragmatism helps her to survive.
4. **Walter Lee Younger -** The protagonist of the play. Walter is a dreamer. He wants to be rich and devises plans to acquire wealth with his friends, particularly Willy Harris. When the play opens, he wants to invest his father's insurance money in a new liquor store venture. He spends the rest of the play endlessly preoccupied with discovering a quick solution to his family's various problems.

Students will break up into groups of 3 and 4, where each group operated as the main characters of the Younger family listed above. Each student will be assigned a character to research and reflect upon. The goal is to compare and contrast the hardships each character had to face in the 1950s to those the student's will face in present day.

Part I: 25% of total project grade

Introduction to the project

- Read and discuss the summary of the plot of "A Raisin in the Sun"
- Discuss the symbols from the story; followed by students drawing a representation of the symbol that means the most to them on a blank piece of paper. Once your symbol is drawn and outlined with dark ink, it needs to be transferred to a piece of graph paper
- Create a group copy of this document and name and share with group. Each group member is responsible for copying the original rubric and grading him or herself using the rubric and for evaluating group member's work on the rubric. Color-code your comments to each other.
- Each group member should upload a picture of his or her graph for analysis.

- Each group member should write a short reflective paragraph under his or her rubric explaining why you scored yourself as such and comment on strengths and areas of improvement.

***Equation Sheet*:** The sheet of paper that shows all your work and final equations for the 8 lines you are finding the equations of; this paper needs to be neat and organized (*It may be a good idea to color code your equations.)

Find the following…

1. Write an equation for two horizontal lines (y=#).
2. Write an equation for two vertical lines (x=#).
3. Write an equation for two lines showing a positive slope. (Rising in Quadrant I)
4. Write an equation for two lines showing a negative slope. (Rising in Quadrant II)

When you are finding the equation of the lines with positive and negative slope you are going to identify two points on each line (do one at a time). Then find the slope between the two points. Then write it in slope-intercept form. Place your equations (8 total) and your work for positive/negative slope lines on a separate sheet of paper (notebook, graph, or computer paper). Provide some way for the equation to be easily connected to the line on your graph animal.

Due Date: Friday, February 27, 2015 at the ***beginning*** of your class period. Ten points will be taken off for each day it is late. Use the rubric to help guide you along
If you have questions, see Mr. Ferguson ASAP!

Appendix B

Part II. Ten Years from Now

Part II. 25 Points of Total Project Grade
This portion of the project is where students begin thinking about their lives and use math to solve equations and consider if the women of the Younger family are able to finance their dreams and support themselves as a family.

A. Your Dreams
Take about fifteen minutes to discuss your future with your group members
Question each other's life choices
Are they being realistic or just fantasizing?
Are you a wishful thinker or a go-getter?

B. Do the Math for the Younger's Dreams and Prepare a Recommendation Report
Consider the desires of each member of the Younger family and the internal and external conflicts they face as they try to make their dreams a reality despite obstacles such as poverty, racism, and sexism in the 1950s. Simultaneously, we are using the following math skills to solve the problems below:

Exponential growth model A = P(1 + r)t **A = amount of interest gained over time** **P = principal or initial amount** **r = interest rate/100** **t = time in years**	**Linear growth model** **C= (m - b)x** **C = cash flow after bills are paid** **m = monthly income** **x = number of months** **b = monthly expenses (transportation, groceries, clothes, and utilities) *This information needs to be researched from a reliable source**

Your groups will be operating as modern Younger families. Each of you will compare your life choices to a character (Walter, Ruth, Mama, and Bennie) from the play *A Raisin in the Sun*.

1. **Lena Younger ("Mama") -** Walter and Beneatha's mother. The matriarch of the family, Mama is religious, moral, and maternal. She wants to use her husband's insurance money as a down payment on a house with a backyard to fulfill her dream for her family to move up in the world.

Situation: Beginning in the 1930s, the American Institute of Real Estate Appraisers began to use a ranking system that assessed risk based on the racial composition of the community. The English, Germans, Scotch, Irish, and Scandinavians ranked at the top of the list while "Negroes" and "Mexicans" ranked at the bottom of the list. Lending institutions and the federal government employed underwriting guidelines that favored racially White, homogenous neighborhoods and led to the creation of a separate and unequal lending and financial system.

Occupation	Salary in 1950s	Dreams	Obstacles
Seamstress	?????(You need to research and provide a valid source)	House (Price the Younger family has to pay: $27,000; Actual cost:$14,000)	After making a down payment of $3500, Lena discovers that she must pay $27,000 to purchase the home, though it is only worth $14,000. As if things could not get any worse Lena has accepted 30 year mortgage financing at 5% interest

- Using the exponential growth model, calculate the total interest after 30 years and add it to the cost of the house. You then need to determine the amount of the monthly payment if the house is to be paid off in 30 years.
- Once you obtain the average salary of seamstress in the 1950s, determine how Lena will be able to contribute to the monthly mortgage payments. Will she be able to cover it by herself or will she need some assistance?

2. **Beneatha Younger ("Bennie") -** Mama's daughter and Walter's sister. Beneatha is an intellectual. Twenty years old, she attends college and is better educated than the rest of the Younger family. Some of her personal beliefs and views have distanced her from conservative Mama. She dreams of being a doctor and struggles to determine her identity as a well-educated black woman.

Situation: To an eighteen-year-old, the expense of financing a loan four years down the road is an abstract concept; but attending the school of their dreams is a concept that is very real. In the 1950s, it was not uncommon for people to put themselves through college. Students could wait tables at night or get a summer job to pay their tuition, room and board. Some African Americans did have opportunities to become professionals--doctors, lawyers, and teachers. Those who wanted to get advanced degrees were held back by a separate-but-unequal school system. In Tennessee, this meant going to black-only colleges or going out-of-state. Even after desegregation of public universities, getting admitted was sometimes difficult for blacks. The local University of Tennessee Medical School effectively kept them out by excessive costs and poor recruiting efforts.

Occupation	Salary in 1950s	Dreams	Obstacles
Doctor	?????(You need to research and provide a valid source)	To be successful physician	Bennie struggles to maintain secure position at the black owned hospitals after being rejected by every white regulated hospital in the area. While seeking employment, her student loans continue to grow at a rate of 7% a year.

- Using the exponential growth model, calculate the total interest after 10 years and add it to the $30,000(cost of medical school in the 1950s). You then need to determine the amount of the monthly payment if the loan is to be paid off in 10 years.
- Once you obtain the average salary of doctor in the 1950s, divide by three. Since most of the black people in the area do not have health insurance, Bennie has to settle for a third of the salary a doctor at a white hospital would make. Determine if Bennie will be able to contribute to the monthly mortgage payments. If yes, how much would be a reasonable contribution?

3. Ruth Younger - Walter's wife and Travis's mother. Ruth takes care of the Youngers' small apartment. Her marriage to Walter has problems, but she hopes to rekindle their love. She is about thirty, but her weariness makes her seem older. Constantly fighting poverty and domestic troubles, she continues to be an emotionally strong woman. Her almost pessimistic pragmatism helps her to survive.

Situation: America has the best dressed poverty the world has ever known it is much easier in the United States to be decently dressed than it is to be decently housed, fed or doctored. At precisely that moment in history, where for the first time a people have the material ability to end poverty, they lack the will to do so. They cannot see, they cannot act, and the consciences of the well-off are the victims of affluence.

Occupation	Salary in 1950s	Dreams	Obstacles
Seamstress	?????(You need to research and provide a valid source).	She wants to have a healthy baby.	During that time period, the death rate was abnormally high for black babies in comparison to other ethnic groups. Ruth wants to ensure her baby's delivery is perfect but she does not have health insurance. She decides to take out small loan to cover medical expenses. Ruth managed to get a loan with an interest rate of 50% per year.

- Using the exponential growth model, calculate the total interest after 5 years and add it to the total of the loan. You then need to determine the amount of the monthly payment if the loan is to be paid off in 5 years.
- Once you obtain the average salary of seamstress in the 1950s, determine how much Ruth will be able to contribute to the monthly mortgage payments. Will she be able to cover it by herself or will she need some assistance?

4. **Walter Lee Younger -** The protagonist of the play. Walter is a dreamer. He wants to be rich and devises plans to acquire wealth with his friends, particularly Willy Harris. When the play opens, he wants to invest his father's insurance money in a

new liquor store venture. He spends the rest of the play endlessly preoccupied with discovering a quick solution to his family's various problems.

Situation: In the 1950s, a Black person's annual income was around $3,828 but a White person's was $7,057. By 1956 a Black person's income was around $4,768 and a White's income was $9,060. As you can see from these figures, because of segregation and the various laws around Black and White people, White people led a much higher standard of living compared to Black people. This was one of the factors that affected the difference in being able to vote or not. Michael Harrington, an American academic and political activist, strongly attacked the unequal distribution of America's wealth and the failure of the government to make sure that everyone had proper medical care when they needed it:

Occupation	Salary in 1950s	Dreams	Obstacles
Chauffeur Liquor store owner Walter will be able to generate two incomes	?????(You need to research and provide a valid source) This salary must consider the cost per year to raise two children.	He wants to invest in a liquor store. The cost of Walter's dream is $75,000. The initial investment for the store is $30,000; $10,000 is needed from three investors (Walter and two other friends).	After several failed attempts, Walter finally gets approved for a small business loan with a 5% interest rate.

- Using the exponential growth model, calculate the total interest after 10 years and add it to the total of the loan. You then need to determine the amount of the monthly payment if the loan is to be paid off in 10 years.
- Once you obtain the average salary of a chauffeur in the 1950s, determine how much Walter will be able to contribute to the monthly mortgage payments. Will he be able to cover it by himself or will he need some assistance?

Appendix C

Student Sample of the Recommendation Report[1]

March 20, 2015

The Youngers Family
111 Main St
City, USA 12345

ATTN: Walter, Beneatha, Lena, and Ruth Younger

Dear Younger Family,

We decided to provide the Younger family with a report that recommends whose dreams can be financed. Racial discrimination was common in the 1950s; African Americans struggled to survive based on the color of their skin. The Younger family had many financial needs such as poverty, racial discrimination, and most importantly the need to fulfill their own dreams. The American Institute of Real Estate Appraisers was a government association that established ranking system based on their race. Whites were labeled at the top of the list while African Americans were ranked at the bottom. Since the racial discrimination was taking place in the 1950s, people of color had been charged way more money than White people on real estate. In fact, Black people who bought a house back then were more likely to pay twice as much for the house than White people. Less than two percent of the Federal Housing Association (FHA) loans were made to non-White home buyers in the 1950s. The FHA was the first federal agency to openly counsel and support segregation, which furthered the notion of racial discrimination of the time.

Financial Needs

The Younger family spent a lot for financial needs. Here is a list of the types of food they would buy and the prices. For this time period, this was a lot of money since their salary was super low each month:

What??	Prices
Sugar	$0.85 for 10 pounds
Vitamin D Milk	$0.84 per gallon
Ground Coffee	$0.70 per pound
Bacon	$0.50 per pound
Eggs	$0.24 per dozen,
Fresh Baked Bread	$0.17 per loaf
Electric Bill	$11.00 per month
Gasoline	$0.18 per gallon

Cost of Dreams

Lena Younger has the dream to buy a house with a yard to garden. In order to fulfill her dream she needs to know the amount she needs to finance, the monthly mortgage payments, and the total amount that will be paid over a number of years. Ruth Younger's dream is to have her second baby in a hospital where the baby can get medical attention to have a better chance of survival. She needs $500 in order to finance the cost of hospital cost. It is very necessary to calculate the cost for hospital care, because her interest rate is 50%. In order to find out the yearly and monthly cost over time you have to calculate

[1] For clarity purposes, student sample minimally edited for missing punctuation.

calculating the years and divide that by 12 since there are 12 months in a year. Beneatha's dream is to become a doctor and the amount of money that she needs is $5,265. It is important to calculate this cost because she needs to know how much money she will need for medical school.

Incomes

Character	Amount needed to financed and reason	Interest Rate for the money	Total amount paid over how many years and at what cost per month?
Lena Younger	$23,500	5%	Monthly: $282.13 30 Years: $101,565.64
Bennie Younger	$30,000	17%	Monthly: $491.80 10 years: 491.78
Walter Lee	$75,000	5%	Monthly: $1,018.00 10 Years: $122,167.00
Ruth Younger	$500	50%	Monthly: $316.40 5 years: $63.28

We must consider the incomes of the household family members because it helps them know how much everybody needs to contribute, so all dreams can become possible. Lena Younger who works as a seamstress makes $267.50 monthly with an interest rate of 5%; however, she needs a total amount of $23,500. In order to pay the mortgage on the house, each family member needs to contribute equally. Failure to do so can result in foreclosure, unless they keep up with the mortgage payments.

A second item to consider is Beneatha's medical school expenses. Mama must pay off the house in the hopes of Beneatha graduating from medical school, getting a job as a doctor, and coming back to help Mama with the house.

It is necessary to also consider the cost of birthing a child in the hospital because it shows that the cost of getting medical help after the birth of a newborn baby is costly, and since Ruth is a Black woman it is going to cost twice as much as it would for a White woman.

Character	Occupation	Approximate monthly income in the 1950s
Lena Younger (Mama)	Seamstress	$267.50
Beneatha Younger	Medical School	$491.80
Ruth Younger	Seamstress	$267.50
Walter Lee	Chauffeur	$192.40
Total:	None	$1,217.20

Conclusion and Recommendation

According to our report, we found out that it is not possible to finance all dreams so we calculated the total cost of all dreams and gave us a total of $1217.20. Based on the calculation we recommend the Younger family should finance the payment of the house. Firstly, if the Younger finished the payment of the house, then they do not have to depend on other people for shelter. Secondly, the liquor store will waste a total amount of $75,000. In a business, the Younger family would spend a lot more money than usual, because they would spend more on the license, reconstruction of the business, rent, and items such as tables, chairs and alcohol. In addition, Walter would have difficulties attending both jobs. Beneatha would spend $491.80 to finish medical school and spend more money on books and supplies. However, we provided a solution that will provide her a scholarship. Ruth who is pregnant needs to provide care for her children such as clothes, diapers, and food. However, the family would have difficulties in raising another child so we provided a solution of getting Ruth on the Women, Infants, and Children (WIC) program. This is an organization to help out people who struggle economically to provide children with needs such as food, water, clothes, and diapers. The payment of the house may be expensive but useful to allow the family to stay together.

Methods, Maps, and Meaningful Mathematics

Maria del Rosario Zavala
San Francisco State University

Abstract

This article is a reflection of one mathematics educator's journey towards being a critical mathematics teacher educator. By illustrating the manner in which she selected, developed and provided an opportunity for bilingual pre-service teachers (BPSTs) to teach a mathematics lesson with a social justice component to fifth graders int~~o~~ a methods course, she reflects on her own growth and its potential for transformational pedagogy with her students and their future students. The decision making process of task selection, introduction of the task to BPSTs, and the support provided to them to teach the lesson, is articulated in order to make visible the challenge in transforming a teaching practice. Mathematics educators who are also seeking to infuse more social-justice focused mathematics activities into their methods courses may relate to ideas in this article, and find support in reading the processes of an early-career teacher educator asking questions of her own praxis.

Maria del Rosario Zavala (mza@sfsu.edu) is an Assistant Professor of Elementary Education at San Francisco State University, where she teaches mathematics and bilingual education courses. Dr. Zavala's research focuses on equity issues in the mathematics education, the mathematics experiences of Latino/as and other historically marginalized populations, and culturally responsive mathematics teaching.

Methods, Maps, and Meaningful Mathematics

Maria del Rosario Zavala

Social Justice in a Bilingual Mathematics Methods Course with a Field Component

This article is about my growth and development as a mathematics teacher educator, and how I strive to "walk the walk" when it comes to teaching future elementary school teachers about mathematics for social justice. I borrow the alliteration in the title of this piece from Gutstein's (2013) chapter in *Rethinking Mathematics (2nd ed)*, entitled *Math, Maps, and Misrepresentation*. In that chapter, Gutstein shares the experience of presenting a task to his 8th grade students in which two world maps, the Mercator and Peters projections, portray landmass differently.

The Mercator map, which is present in almost every schoolroom in the US, distorts the landmasses of the southern hemisphere and makes the US, Europe, and Russia appear larger than they are. The Peters map, on the other hand, is designed to preserve relative landmass; countries that are bigger on the globe also look bigger on the map. Gutstein explored with his students how mathematics illuminated the misrepresentation of countries on the Mercator map which then led them to questions about what other information has been misrepresented as part of their education, and what colonial legacies are embedded within something as simple as a map.

The focus of this article is on how and why I, as a mathematics educator, selected this task for my bilingual pre-service teachers (BPSTs) to implement with fifth grade students in a field-based methods course, and what was learned from that experience. The decision-making processes I engaged in as I introduced the task to BPSTs, supported them during the planning session, and then debriefed the activity after they tried it with fifth graders is explored. Sharing the details of this experience will contribute to the development of fellow mathematics educators, who want to better understand what our future elementary teachers get out of being supported to plan and enact an activity designed to infuse social justice into doing mathematics.

Bilingual Teacher Preparation: Towards *Educar Para Transformar*

I teach mathematics methods to BPSTs in a program that is moving towards an *Educar Para Transformar* model of teacher education. As Flores, Sheets, and Clark (2011) describe, the focus of this model is on "transforming program faculty, as well as *aspirantes'* (BPSTs') ideological positions, knowledge, and skills." (p. 13). The ultimate goal in such a model is teachers, or in their term *aspirantes*, who teach for freedom: "Prepared to lead, they advocate and bring about change in self, bilingual learners, schools, and communities." (p.14). Even naming candidates *aspirantes* communicates that they are aspiring towards something bigger than typical teaching as we know it. As we strive toward cohesion in our program around *Educar Para Transformar,* we also engage in personal transformation. For me, this transformation is centered on how I shift my thinking and actions around what teaching mathematics for freedom means. I turn to bodies of work in teaching mathematics for social justice (such as Gutstein, 2006; Gustein & Peterson, 2013; Wager & Stinson, 2012) as a starting point while I continue to evolve in my understanding of what teaching mathematics for freedom with Latin@ populations means.

The SF State program's focus on Spanish-immersion classrooms in urban schools draws many future teachers from around the bay area, including the local San Francisco communities that we focus on serving. Most of our students are Latin@, born and raised in the United States; many grew up speaking Spanish in the home, others are heritage language speakers. Most of our students begin coursework for their teaching credential the semester after they

graduate from college [1], but we frequently have older students returning to school after starting families or teaching as paraprofessionals in schools.

I strongly identify with our students who were born and raised speaking Spanish in some contexts, and English in others. Bilingualism is a spectrum, on which I identify myself as not fully fluent in Spanish, but with sufficient skills to converse, do some teaching, and to identify and pick up academic language for teaching mathematics. In our program, the unofficial Spanish of classrooms situated within urban areas of the United States melds with each of our experiences – as Mexican, Central American, Peruvian, and/or multi-generational US-born Spanish-speakers, some with formal study in the language and others with less formal study. It is in this context that we negotiate not just what it means to teach and learn mathematics, but also the Spanish, English, and mathematical languages that goes with it.

Goals of the Mathematics Methods Course

Most of the BPSTs bring strong commitments to social justice for Latin@ families. Many of our students are active in local campaigns around gentrification and displacement impacting the Mission district, an historically Latin@ neighborhood in San Francisco. However, as within any teacher education program, our students do not necessarily share a vision of social justice for teaching mathematics. These commitments and the BPSTs' experiences as mathematics learners make for widely different beliefs of how to teach mathematics; from wanting to model everything step by step for students, to wanting to connect mathematics to the real world. The three key instructional principles I strive to have them leave with are:

> 1) Doing mathematics is a social activity, in which the teacher facilitates student learning by attending to both content objectives and the identity development of students; 2) Mathematics must be relevant to and responsive to students' needs, lived experiences, home lives, and communities; 3) Teachers have a lot of power over students' attitudes towards math, both in how they model enthusiasm for the subject, and how they socialize students into what is productive engagement with mathematics.

To me, there are aspects of social justice in each of those these principles, but to get at the heart of what Gutstein (2006) calls *reading and writing the world with mathematics*, a teacher needs to start with expanding their understanding of what counts as doing mathematics, and what kinds of knowledge get privileged - traditional, community, or critical mathematical knowledge. Therefore, in methods courses taught by me, I want to make sure that I as the mathematics educator introduce examples of tasks that shift the understanding of what counts as mathematics, and open up spaces for students to draw on their knowledge of situations and sense of fairness as they learn mathematics.

I typically teach this course at the beginning of the second semester, in partnership with a fifth grade teacher, at a local elementary school. This teacher is also a graduate of and mentor teacher in our program. We launch the mathematics methods course with four full days of cycles of learning mathematics, planning activities to teach, teaching mathematics activities to fifth graders, and debriefing afterwards. The BPSTs teach the students in Spanish, so much of our planning time is in Spanish as well as English.

It was my hope that by selecting a task to try out with fifth graders, and engaging the BPSTs in how to implement the lesson, I would support the BPSTs to engage in aspects of teaching mathematics for social justice.

Reflections on the Teacher Educator Planning Process

I came to the decision to have BPSTs teach the Maps task (Gutstein, 2013) through a reflective process. In this section, I will share with the reader how I engaged in a sense-making process around how to select the task and decide to give it time in the course. Though my thoughts on this continue to evolve, I offer these reflections on where I was in that moment in time.

Why did I incorporate this kind of task? The answer to this question is deeply entwined with who

[1] This is typical in California, where the credential is a post-baccalaureate degree.

I am as a mathematician, a teacher, and my commitments to Latin@ students, adults and children. When I plan the methods courses, I typically engage equity issues through discussions about identity, culture, and status in the classroom. I often have students read examples of teaching mathematics for social justice from the *Rethinking Mathematics* book. I realized in my third year as an assistant professor, supporting my students to teach a critical mathematics lesson was missing from my syllabus. I think this is because I had extensive and excellent preparation in how to support general populations of elementary pre-service teachers (PSTs) to learn how to enact mathematical practices that engage students in sense-making and problem solving, but not as much training in how to support PSTs to design and implement tasks that help their students understand and act on a social justice issue. Further, I often felt like I had to privilege content knowledge because within the bilingual program many of our BPSTs had not had adequate opportunity to learn enough mathematics to be able to teach it in deep conceptual ways. My commitment to transformative education was often trumped by my commitment to help the Latin@ future teachers learn more mathematics to boost their teaching confidence, so that they could effectively teach foundational mathematics concepts to future generations of Latin@ students.

In my methods classes, I was not privileging teaching for social justice in the way I was privileging teaching through problem solving (Van de Walle, Karp, and Bay-Williams, 2015), and attending to status issues in the classroom (Featherstone et al, 2011), in part because without a comprehensive curriculum of critical mathematics tasks teachers must create it as they go. For that reason, I often encouraged my students but did not require that they incorporate social justice into their final mini-unit planning assignment.

I find inspiration in mentors and other educators who support their students in infusing social justice into a lesson that they planned as part of their teacher preparation coursework (Aguirre, 2009; Koestler, 2012). The field experience with my bilingual cohort further provided the opportunity to go beyond planning and have them actually teach the lesson. The research on novice teacher learning in which PSTs enact and reflect on their teaching within methods courses suggests that PSTs are better prepared to try out complex tasks in their own classrooms when they have been supported to try out similar versions with a coach or with the support of classmates (Lampert, Franke, Kazemi, et al., 2013). Based on this research, I decided to take two of the four days with fifth-grade students to have the BPSTs lead a mathematics lesson connected to social justice. Reformatting my class time to privilege experiencing and implementing a social justice mathematics task was a key step in my development as a critical educator.

Why am *I* selecting the task, if building agency is part of a social justice pedagogy? As Gutstein (2007) wrote, a main goal of mathematics and social justice is for students to develop agency with mathematics, to be able to generate their own questions and also take actions to solve issues. It is therefore not lost on me that even while building my BPSTs' agency was a goal, our first few forays into teaching mathematics needed my guidance. To me, this meant bringing a task to the BPSTs, letting them experience and analyze it as learners, and then allow for agency in how they worked through it with the fifth grade students. I also needed to take the long view and see it as one small step in a long road of development in their careers as teachers. Therefore I selected the task and gave them the responsibility of planning how to teach it.

A big question in this research is whether or not mathematics for social justice can truly be taught when there is no or little relationship between students and teachers. This continues to be a big question for me. I did not doubt my ability to engage the BPSTs in this task having begun building rapport the prior semester, but I did wonder what BPSTs would be able to accomplish and understand about this lesson given that they would have just spent a total of two hours with the students the prior week. Would I be perpetuating a new bad practice that as a teacher you can bring any activity that you think is about social justice and expect buy-in from your students? Such a stance seems to fly in the face of teaching for freedom, if the teacher has so much control and so little established relationships. Then again, could we claim that students simply would not engage in any kind of task before teachers have established a deep relationship? It seems like either

extreme holds little explanatory power about learning. Even though one of our first-day tasks was a "get to know you task" with the children in a circle and they worked with the same 7-9 children each day, BPSTs did not have the relationship or rapport that Gustein (2006) and others describe as a key piece of engaging in the dialectic praxis of teaching for social justice. This is another reason why this activity must be described as a facsimile, an approximation of a practice in teaching much like the rehearsals described in the work of Lampert et al. (2013). It is the right size to allow the teachers to practice implementing a complex task, but lacks deep relationships between students and teacher. Although I did have that concern, I argue that the activity was useful to help BPSTs develop their own understanding of how an activity such as this one could work, and create a vision for how to implement such tasks with their own students in the future, who they will know in deeper ways.

BPSTs Learn About and Plan the Map Task

I ultimately decided to modify the Gutstein (2013) Map Task for fifth graders. The use of visual aids was a strong point in this task, giving both teacher and students physical materials to manipulate and reference. The mathematics of ratios was just out of reach for most of the fifth graders, but they all had a lot of experience with division by this time. I also thought that even the students who could not quantify difference in representation of landmass could cut out and hold up two different representations of the same landmass (Brazil, for example) and experience the difference in sizes to draw conclusions about difference in representation (i.e., Brazil in the Peters projection would be bigger than in the Mercator given the same sized map). Also, the task could culminate in asking students to say which map they thought was more fair and why, drawing on their personal sense of what is fair. I ran the ideas for the task by my fifth grade partner teacher. He was enthusiastic about it, adding that it had multiple entry and exit points, meaning that students could start to tackle it in different ways, and that the fifth graders may get different but equally valuable lessons from it.

To launch the activity in the methods class, I first located a short video on Youtube[2] that showed various map projections being morphed from the globe. Each video highlighted how some part of the globe is distorted to shift from the surface area of a perfect sphere to a rectangular shape. I also peeled an orange and asked if anyone thought they could arrange the peels into a perfect rectangle. Everyone seemed to understand that distortion was inescapable when mapping the globe onto a two dimensional rectangular map.

I then introduced the task by having the BPSTs think-pair-share differences between the two projections of the maps: the Mercator and the Peters. Their observations ranged from beginning to quantify differences in sizes of continents to reflecting on how they had never seen or only rarely seen a Peters map, questions arose, "*why is that? Who makes Mercator maps, and why are they more prevalent in classrooms?"* The BPSTs not only enjoyed the activity, they immediately saw that there was a relevant issue of fairness in the activity. From there, I supported their transition to using mathematical arguments to make claims about the differences in "fairness" that they were noticing. They used the tracing graph paper to trace shapes of various pairs of countries on the Mercator and Peters projections, and recorded these areas (using graph paper squares as the unit of measure) on a t-chart. Then they calculated the ratios between graph paper landmasses and found how they compared to actual ratios between landmasses, which they researched using their phones and laptops. This also brought up a discussion for us about what sources were reliable or better on the internet, including which reported in square kilometers versus square miles and whether one was more appropriate for the classes we were working with.

Many BPSTs struggled with the concept of ratio in this context. Some of them were not always sure what the answers to the divisions they were doing meant. I facilitated discussions in groups about how to phrase what the results of their calculations meant

[2] From the PBS show Life by the Numbers, we watched the animated portions of this clip https://youtu.be/X4wgFSHZXBg?list=PLSfHj8toBl183XJbJkqLSNWhZroSC4HGl

(e.g., "If you are comparing New Zealand to Brazil, and your calculation gives you 1/32, then this means Brazil is 32 times bigger than New Zealand."). They also were not always sure what having two similar ratios, between the same two countries on each projection, should mean. Mathematically, this should mean that those landmasses are less distorted on the Mercator map, as is the case with countries near the equator. In our discussions of how to calculate relative size of one country's area to the other, we discussed all these issues. I concentrated on facilitating talk by probing thinking, eliciting ideas, and validating contributions made with words, partially formed ideas, gestures, etc. I looked for many ways to validate thinking.

As we talked, many BPSTs took notes on how to calculate the ratio of two landmasses and what the ratio meant, and how to express mathematical relationships using Spanish academic language, for example: "____ es _____ veces mas grande que _____ en el mapa Mercator, " as a sentence frame for "___ is __ times bigger than _____ on the Mercator map." They wanted to ensure they had noted the key mathematical talking points for discussions with the fifth graders, and to be ready to provide academic language support during the lesson. To me, this also signaled that they were taking the mathematical ideas in this task seriously, and knew that the value of the task was both about how students would experience the maps differently (ex. though Mexico is smaller than the United States, it appears even smaller on the Mercator than the Peters map), but also how they would express mathematical evidence about how they were different (ex. "Mexico appears to be about 12 times smaller than the total landmass of the US on the Mercator, but is only 6 times smaller on the Peters."). This was also important for me to witness, since I was not sure how the activity was going to be received, and if it would pose any challenges given their wide range of confidence in their own mathematics skills.

At some point in the learning portion, I found a reasonable place for us to pause, reflect on what we had figured out for ourselves, and to make a decision about the kind of guidance to give the pre-service teachers as they headed into planning with their teaching partners. I needed to ensure everyone felt comfortable with the mathematics of the task, but also encouraged them to not get bogged down in the calculation for this activity but to focus on using mathematical evidence to support arguments for which map was more fair. In retrospect, I felt a strong urge to give them a pep talk, since this kind of activity situated within a mathematics lesson was new to them, and new to the fifth graders, and I wanted them to go into it with energy and excitement even if they were not perfectly clear in their plan for implementation.

BPSTs Lead the Task with 5th Graders

There are many layers of learning on which to reflect in my role as the teacher educator engaging in on the spot observation, coaching, and support of BPSTs working with fifth graders. Here I will share some reflections on what I was learning about the BPSTs in this process.

On the first day, I noticed a marked difference in how various groups of BPSTs implemented the activity with students. It seems like some BPSTs were able to keep the activity open and problem-solving oriented, even while they scaffolded technical skills like expressing amounts as ratios, whereas other BPSTs implemented it procedurally with little input from the students. Watching this unfold I reflected more deeply about unpacking the pedagogies that support the task that is to be implemented in rich ways for students. Even though during planning I had encouraged every group to err on the side of letting the children explore, this seemed to not fit with some BPSTs ideas of what it meant to teach mathematics, even with an open-ended context and having experienced this task as an exploration themselves.

After the first day, the BPSTs reflected and regrouped. Many thought the activity had been challenging to implement. Still, the BPSTs went into the planning phase the next day with fresh energy. Some decided to re-launch, and completely start the activity again. Others decided to use student work as the launching point into the second day. Together the class generated two goals for the day that felt reasonable given where each group had ended the prior day: *discuss what mathematical evidence fifth*

graders found in their exploration, and support the fifth graders to write one or two sentences answering which map they thought was more fair and why. By helping the BPSTs establish these objectives, I can reflect that I was trying to give BPSTs concrete goals from which to organize their approaches. I did not want them to feel lost about the multiple directions the task could go in, so we put some structure around it to have an end goal.

To summarize the second day, more fifth graders were doing focused work than the first day. It seems the one-day familiarity and returning to the task was good for them too, not just the BPSTs. However, BPSTs still noticed and reflected on the challenges of the task. In order to reflect on the teaching in a debrief in the last 30 minutes of the methods class, after an intensive two days with this activity, I asked them to write down simply: "what worked" and "what did not work" today. Some BPSTs wrote about the activity over all, covering the two days, and other noted specifically what came out of just this day. The table below summarizes ideas from the BPSTs' reflections at the end of the second day.

Works
Talking about the maps, students able to identify many differences
Using talk moves to get a variety of students involved in whole class discussion (revoicing, repeating, explaining to their peer)
Reviewing what we did the prior day, going from there
Everyone understood that the two maps were different, but were of the same landmasses (ie countries, continents)
Didn't Work
Too long - this lesson seems like it needs more than two days!
Not having calculators - the calculation took too long since we did not have enough calculators for our group.
Students' reflections didn't all contain math
Too many new concepts at once for most kids

Table 1
BPSTs' Reflections on What Did and Did Not Work Implementing the Map Task

A variety of reflections around what fifth graders noticed or wrote emerged in the BPSTs' reflections, which exposed complexities the BPSTs had to manage that may not have emerged with a more mainstream mathematics task. One BPST noted that it was interesting how a few fifth graders used mathematics to show that the Peters was indeed more accurate to landmass, but had concluded in a closing group discussion that - the Mercator must be the better map because it was in all the classrooms. Another BPST noticed that one fifth grader wrote in her exit ticket, "Yo pienso que los dos mapas son incorrectos, porque nadie puede replicar el mundo actual. Los dos tienen sus imperfecciones / *I think that the two maps are incorrect, because nobody can replicate the real world. The two maps each have their imperfections."* It seems this type of comment was a theme, where fifth graders hesitated to say a particular map was better.

Some BPSTs discussed the importance of a classroom culture in which students can make arguments to defend their position, along with the importance of normalizing these kinds of math activities. The discussion deepened further by leading us to think about how non-mathematical ideas can be valued alongside the mathematical ideas in an activity like this one, in some ways bringing our two-day experience full circle. By returning to the original idea of shifting what ordinarily counts as doing mathematics to including incorporating ideas of fairness, we had come back to our starting points of discussions about mathematical tasks that draw on students' sense of justice as well as mathematics.

Final Thoughts on Growing as a Critical Mathematics Educator

Given how BPSTs focused the lesson debrief on what did not work, I was surprised to hear from most of the BPSTs that this activity was worthwhile, and that activities like the Gutstein Map task needed to be implemented in classrooms more. Some BPSTs offered that despite difficulties this was more meaningful mathematics than they remember learning, and wanted to keep learning ways to design these kinds of activities and make them work in their own classrooms. It seems that an important lesson for me, as the mathematics educator, is that even as BPSTs were critical of their own performance they understood the value of tasks that bring social justice into mathematics, and the value in the process of

thinking through together how to implement such tasks. Feedback of this kind from my students keeps me reflecting on the value of such experiences, even if they are small snapshots of social justice oriented tasks and not embedded deeply in transformative pedagogy. Similar to the research on novice teacher learning of rehearsals of practice (Lampert et al, 2012), it seems that these mini facsimiles of social justice mathematics practice may be useful to give BPSTs the opportunity to envision, enact, and trouble-shoot a teaching practice, so that they can have a stronger starting point to try out such tasks in their own classrooms. However, I conclude that I need to support BPSTs better in seeing that task implementation needs to be situated within pedagogies that focus on developing student agency, voice, and understanding. It is one thing to model how such tasks could work, but it is quite another to unpack it, and to connect it to one's own sense of teaching for liberation. Shifting curriculum is a good starting point, but developing a concrete notion of mathematical pedagogies for freedom is perhaps a longer, more involved process and I am somewhere on that trajectory in my own learning.

As I shift the content of what counts as learning to teach mathematics in my methods courses, I must also shift what it means to show progress in teaching mathematics for freedom. The BPSTs had to let go of some of the control that is normally expected in traditional curricula, and they had to trust that students could generate ideas that were worthwhile. They also had to develop practices that attend to mathematical thinking side-by-side with critical literacy knowledge. This practice stretched the BPSTs in new ways to integrate multiple knowledge bases into a mathematics lesson. I have to be aware of the ways in which the BPSTs are challenged and can rise to those challenges in a task like this. I need to understand how they are growing not just as mathematics teachers, but as critical mathematics teachers.

I also think that I have turned a corner in my own philosophy of teaching. If I am going to *say* something is important, I am going to *model how that value needs to be a priority*, and I am going to *try it out* with BPSTs and children so they can see how it works. I am going to attend to my BPSTs' growth as transformative educators using multiple markers that help me attune to who they are in relation to mathematics, what teaching mathematics for social justice means, and what pedagogies for transformation in the mathematics classroom are from their perspectives. As I grow in this role, I grow as not just a mathematics educator, but a *critical* mathematics educator, *educando para transformar, a mí mismo y a mis aspirantes*.

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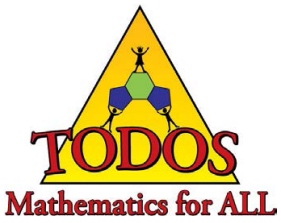

Supporting Prospective Teachers in Using Mathematics to Understand Our World

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Abstract

We, a teacher educator and two of my former students, discuss the role of *meaningful* real-world connections as a means to creating a more equitable and socially just mathematics curriculum. First, Felton-Koestler describes his use of real-world projects in courses for future teachers. Then Sutherland and Tracy describe their experiences with the projects and give examples of the real-world connections they made. Finally, we consider some of the themes across the prospective teachers' work and future directions for implementing this form of teaching in teacher education courses.

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Supporting Prospective Teachers in Using Mathematics to Understand Our World

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Too often the mathematics curriculum is largely disconnected from real-world contexts and when connections are made they are often done in a superficial way with the context serving primarily as a "stepping stone" for engaging with mathematical concepts (Felton, 2014). As a result many students, especially those from traditionally underserved groups, do not see a connection between mathematics and their lives (Abreu & Cline, 2007; González, Andrade, Civil, & Moll, 2001; Howley et al., 2011; Mukhopadhyay, Powell, & Frankenstein, 2009). Moreover, students never learn about the role mathematics can play in understanding, questioning, and changing our world and in combating injustices (Frankenstein, 2009; Gutstein, 2006; Skovsmose, 1994; Turner, Varley Gutiérrez, Simic-Muller, & Díez-Palomar, 2009). Thus, one approach to creating a more equitable and socially just mathematics curriculum is to include authentic connections between mathematics and meaningful contexts that connect to students' out-of-school experiences or involve analyzing and critiquing social and political issues (Felton, 2014). The importance of connecting mathematics to the real world can also be found in the National Council of Teachers of Mathematics's (NCTM's) Problem Solving and Connections Standards (NCTM, 2000) and in the *Common Core State Standards of Mathematics* (CCSSM) (Common Core State Standards Initiative [CCSSI], 2010), especially in the standards for mathematical practice. However, many teachers have limited experiences with making substantive connections between mathematics and the real world and with social and political issues in particular.

In this article, we—Felton-Koestler, a mathematics teacher educator, and Sutherland and Tracy, Felton-Koestler's former students—discuss ways to connect mathematics to meaningful real-world contexts. First, Felton-Koestler discusses how he integrates real-world projects into his methods and content courses. Then, Sutherland and Tracy each describe how they used mathematics to investigate real-world topics in Felton-Koestler's mathematics course for prospective teachers, each of which is followed by an analysis by Felton-Koestler. Finally, we conclude by considering some of the themes that cut across Sutherland and Tracy's work and with suggestions for supporting prospective teachers in learning to integrate real-world contexts into their mathematics teaching.

Felton-Koestler: Social and Political Issues in My Courses

While there is great potential for using mathematics in meaningful ways in the classroom, in my experience and in the research findings, developing mathematics tasks that provide insight into the world is particularly challenging for prospective and practicing teachers (Bartell, 2013; Brantlinger, 2013; Felton & Koestler, 2015; Gregson, 2013). When teaching mathematics content or methods courses, I work to support prospective teachers (PTs) in learning to use mathematics to understand the world by having them complete projects in which they connect mathematics to a social or political issue of their choosing. While the PTs are encouraged to investigate a variety of perspectives on the social/political issue they select, I tell them that they will be required to consider the perspective of those with the least power in society. For instance, some PTs investigate obesity and they sometimes frame this as an issue of poor dietary choices, lack of exercise, and families who do not care enough about their child's well-being. In these cases I encourage them to consider the affordability of and access to healthy food.

In assigning these projects, I specifically emphasize that they are not required to be activities or lessons that would be used with children, so they feel free to choose a topic that interests them. One goal of the projects is for the PTs to experience for themselves what it means to connect mathematics to a real-world context that is meaningful to them. A second goal is that they begin to develop the ability to make these connections so that they are better able to do this when they become classroom teachers. In light

of the difficulties many teachers experience doing this work I see these projects as a first step in highlighting the potential for mathematics to help students understand social justice issues and their world. The projects are open ended; however, the PTs submit several drafts on which I provide extensive feedback. In the following sections, two of my former PTs share examples of projects they created in one of my courses.

Sutherland's Project: Teacher Pay around the World

Prior to Felton-Koestler's class, the mathematics I learned in school was never connected to the world that I lived in, so I learned to keep the two separate. This course showed me how big a role mathematics can play in my life and how I can show that to my future students. I have always been interested in teaching in other countries, so when we were assigned the project for this course I was interested in learning about teacher pay around the world.

When I began looking for data for my project, I started looking for data about yearly salaries for teachers in different nations around the world. Through research I found data from the Organization for Economic Co-operation and Development (OECD) (OECD, 2009a) and the Program for International Student Assessment (PISA) (OECD, 2009b) (see Figure 1 on following page for links). The OECD data revealed the biggest hurdle for my project. I had assumed that teachers around the globe worked approximately the same amount of time in a school year, but the OECD data showed that the average number of hours worked varied dramatically from country to country. I quickly realized that if I compared the average yearly salary for teachers, it would not be an accurate depiction of what teachers were really making for how much they worked. The data presented by the OECD showed information for dozens of countries around the world, which presented my second problem: Which countries would I use for my project? This is where the PISA data was useful. PISA studies student achievement on different tests every three years. I decided to take the countries with the ten highest scores from the PISA list (OECD, 2009b, p. 8) and compare them to the OECD data. I also included the United States, which was ranked seventeenth by PISA. Some of the countries in the top 10 on PISA did not have OECD data available for me to use, so they were cut from the project. Once I had all my data, I began to compute the hourly wage for teachers by taking the yearly salary of the teacher (which the OECD had already adjusted into equivalent U.S. dollars, thus controlling for differences in the cost of living), and dividing it by the average hours worked for teachers of that country. I did this for starting teachers, and for teachers with fifteen years of experience, since both pieces of data were available.

When I finished my calculations, I started writing problems that others could solve about the data I collected to compare the different countries' salaries. I created problems that could answer the questions that I had about the data I created. For example, one question I asked was "A new teacher in the Netherlands makes $36.85 an hour, and a 15-year teacher makes $47.75. What percent increase is this?" Other problems compared hourly starting salaries across countries or found the difference between teachers' average starting and 15-year salaries. This part of the project probably influenced me the most because I saw how I could teach children about social issues by having them do mathematics that relates to them and allowing them to research these issues on their own. One topic that I briefly explored with my own students was determining how many people purchase the video game Minecraft™ each week as a way of learning about multidigit multiplication. Students might extend a task like this by asking about how many purchase it in a year, which would require collecting additional data and/or making assumptions about times of the year that may have higher or lower sales. While this is not an overtly political issue, it was meaningful and relevant to my students.

This project proved to me how powerful it can be to answer your own questions about real world information using mathematics you learned in class. It takes mathematics out of the classroom and attaches it to something real. I experienced how much more meaningful mathematics was when it was directly connected to something that I was interested in.

When I begin teaching I want to teach mathematics so that it connects to who my students are and what

they want to learn. Students are not blank slates to be filled with knowledge by a teacher. They have ideas, hopes, dreams, and questions that can be answered with the information that they learn in school. I hope to be the person that shows them how to connect what they learn in class to the real world. I want them to know that they have the tools to answer all the world's questions, if they only have the desire to do so.

OECD Programme for International Student Assessment (PISA) (http://www.oecd.org/pisa/)

PISA 2009 Key Findings (http://www.oecd.org/pisa/pisaproducts/pisa2009keyfindings.htm)

What Students Know and Can Do, Executive Summary, Figure 1. Comparing Countries' and Economies' Performance (http://www.oecd.org/pisa/46643496.pdf)

Education at a Glance 2009: OECD Indicators (http://www.oecd.org/edu/eag2009)

- Indicator D3. How much are teachers paid?
- Indicator D4. How much time do teachers spend teaching?

Figure 1. Teacher pay resources.

Felton-Koestler's Analysis of Teacher Pay

I see two key strengths in Sutherland's work. First, Sutherland recognized that the quantity of *salary* from her data source was insufficient for making fair comparisons across countries because of the differing workloads. Therefore, she generated a new quantity of *(U.S. equivalent) dollars per hour*. In other words, she engaged in quantitative reasoning to generate a more productive quantity for making comparisons across countries (Thompson, 1994, 2011). Second, she was confronted with a large amount of data (salaries for dozens of countries)—which many PTs find to be overwhelming—so she developed a method of reducing these data down to a few countries of interest, which she decided to do on the basis of PISA scores.

There are also ways in which Sutherland could have more rigorously investigated her topic. For instance, she could have extended her examination of percentage increases in pay over 15 years of teaching to discuss how much each country appeared to value experience. With an eye towards issues of equity and justice, she could have also explored such questions as how teacher pay compares with other professions in the country, whether educators need additional income to earn a living wage, and what standard of living this salary makes possible.

Tracy's Project: School Lunches

At the beginning of our projects we had to brainstorm several possible ideas we might use for our projects. I ended up combining my early interest in analyzing funding levels for schools in Arizona with counting calories in school lunches. I noticed that federal funding has a huge impact on the food that the schools serve. Also, I had noticed increased attention to school lunches in elementary schools, and I wanted to research both further.

One of the main points of the project was to bring in the elementary mathematics. For most of Felton-Koestler's course, I was extremely skeptical that elementary mathematics could be used to understand these real-world issues. However, based on the class activities and readings, I was starting to change my mind, so I approached the project as an opportunity to prove to myself that I could make sense of these issues using the mathematics from our course.

The first part of my project focused on federal spending on school meals in Arizona. Figure 2 includes links to my data sources and some of the information available. Using this information I calculated the average spending *per year* and *per school day* if all Arizona students shared the spending equally (assuming an average of 180 days in a school year). I encourage the reader to consider what other questions could be asked with the data shown in Figure 2 and what additional information might be valuable to research.

The second part of my project focused on the nutritional content of school lunches. When I went to do my research, I found that there was a lack of publically available food menus from some of the schools. The ones that I found seemed to over emphasize the healthy foods being served. This was extremely frustrating, so I conducted my own research. I went to a local school that had advertised their healthy menu online and observed the food for myself.

I used the government site choosemyplate.gov to determine nutritional information from the data that I collected from the schools. I was shocked to find that the food actually being served frequently exceeded the recommended daily intake for things like calories and sodium. I was then able to create a variety of mathematics questions. For example, one question I created was: "it is recommended that a 14 year old eats 46 grams of protein each day. At school, Cameron (age 14) consumes 85 grams of protein. How many times the recommended daily allowance of protein did Cameron have at school?" This is a multiplicative comparison, number of groups unknown problem (CCSSI, 2010, p. 89). I wrote different types of mathematics questions commonly found in elementary school (see CCSSI, 2010, pp. 88–89) by looking at recommended nutritional amounts compared to how much they were getting at school, or by finding out how many calories or how much sodium is allotted to the children for the rest of the day.

I learned so much from this project. It gave me the opportunity to see my topic up close and hands on. I saw that the elementary mathematics that we teach our students can be used with real world contexts. Solving problems without any real world context may not be effective for many of my future students and would not allow me to engage in the authentic teaching that I plan to use. I believe that when teaching mathematics concepts to students we should not underestimate their ability to handle the context that goes with it.

This class definitely changed the way I am going to teach not only mathematics, but all subjects. In the beginning of the course I wrote that real world connections should initially be limited to basic, everyday topics that students "see or think about naturally" before getting into more complex and "'loaded' real life questions." At the end of the semester, I wrote that "in this class I have learned that the world and its views on different topics are constantly changing, and as a future teacher I need to be willing to change with it."

Federal Education Budget Project by New America Foundation.

- General: http://febp.newamerica.net/
- Arizona: http://febp.newamerica.net/k12/AZ
- 2011 Federal School Meal Funding in AZ: $296,544,150
- 2011 Total students in AZ: 1,071,751
- 2011 Percentage of AZ students enrolled for free or reduced lunch: 45.0%

ChooseMyPlate.gov (http://www.choosemyplate.gov)

Figure 2. School lunches resources.

Felton-Koestler's Analysis of School Lunches

I see two critical strengths in Tracy's project. First, many of the PTs in my courses struggle to find relevant and understandable data for exploring their topics. While not all PTs are in a position to collect their own data, I felt Tracy's (self-initiated) investigation into the food being served in a local school was an example of agency (Felton & Koestler, 2015; Turner, 2012). Second, she was shocked that school lunches (a single meal) often exceeded recommended *daily* allowances and she created problems that she felt illustrated these discrepancies. Thus, she created mathematics problems that, within the broader narrative of her project, were meaningful in that they illustrated the unhealthy nature of school lunches.

As with Sutherland's project, Tracy's work could also be strengthened by a more critical investigation of her topic. For instance she could have considered how much the extra calories/sodium/protein will affect someone's health, evidence of how it may affect rates of obesity or diabetes, and the economic impact of those health costs down the line.

Conclusion

Most of the PTs I (Felton-Koestler) work with have little to no experience making substantive connections between mathematics and real-world contexts (Felton & Koestler, 2015), and many practicing teachers and teacher educators struggle to make these connections in their own practice (Bartell, 2013; Brantlinger, 2013; Felton, Simic-Muller, & Menéndez, 2012; Gregson, 2013). Thus, I consider the work above to be a valuable first step in supporting PTs in making these connections in their

future practice. Both projects may be critiqued because they appear to use typical story problems with a slightly new context. While I agree with this concern, I also think it is lessened by the fact that these problems were part of a broader investigation (as opposed to stand alone word problems) in which they were meant to illustrate some of the concerns or findings the PTs had uncovered in their work.

While the level of social critique found in these projects is not what we would expect to see from a mathematics educator such as Gutstein (2006), who has extensive experience with, and is deeply committed to uncovering and investigating social injustices, it does represent an important step in coming to see mathematics as providing insight into our world. For PTs who entered my course feeling that "school was never connected to the world that I lived in" and that the use of mathematics should be limited to "everyday topics", the use of mathematics to examine inequities in teacher pay or the costs and quality of school lunches do, in fact, represent "controversial" or "political" topics that they are not used to seeing investigated with school mathematics.

Another common theme across Sutherland and Tracy's experiences was that they had an opportunity to experience what it means to connect mathematics to meaningful contexts. Both of these contexts were of personal interest to the PTs and they analyzed them in ways that furthered their understanding of the issues at hand. While their particular topics may or may not translate well into work with children, they both have embraced the idea that teachers should seek out ways to connect mathematics to their students' lives. As discussed above, this is one aspect to creating an equitable mathematics curriculum in that it positions students as problem solvers who are capable of using mathematics to understand problems both in their more immediate lives and in the world writ large.

In moving forward with this work with PTs, I am working to develop a collection of example projects that highlight some of the strengths discussed above, but that also include critical commentary, such as raising questions about how to more critically investigate one's topic. I intend to include discussion of these examples in my courses and then require PTs to bring in drafts of their projects for peer critique in which their peers can raise questions about other ways they might consider investigating their topics.

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Strategies for Creative Insubordination in Mathematics Teaching

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Abstract

Mathematics teaching requires political agility on the part of teachers who must negotiate their contexts in order to advocate for their students. Yet, most teachers of mathematics are not prepared for this work. This article presents a set of strategies that teachers can use in their everyday interactions with administrators, colleagues, parents, and students when political scenarios arise related to mathematics teaching and learning.

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Strategies for Creative Insubordination in Mathematics Teaching

Rochelle Gutiérrez

Teaching involves making complex, everyday, in-the-moment decisions that have clear impacts on students, colleagues, and even teachers themselves (Schoenfeld, 1999). Whether or not to call on a student during class; how many points to give on a test problem; to what extent students are allowed to work in groups; or whether to offer time afterschool to help students who are not performing well in class all have consequences for students and teachers alike.

However, most teachers do not see their everyday decisions as *political acts*; instead, they develop the view that teaching is only political when introduced to concepts like "social justice mathematics teaching" or "culturally relevant mathematics teaching" (Aguirre, 2009; Gutiérrez, 2015a; Bartell, 2013; de Freitas, 2012; Gutstein, 2006; Leonard et al., 2009). While we strive to make a positive impact on all of our students, schooling contexts can change that. High stakes education, Response to Inter-vention initiatives, Race to the Top campaigns, and the latest packaged reforms can keep us from acting on what is in the best interest of our students and their learning.

Given the current state of high stakes education, those of us who want to advocate for our students may feel we have few options other than to bend the rules or be quietly subversive behind closed doors. Rather than reinventing the wheel, we can learn from teachers who have successfully negotiated the politics in their work settings to advocate for their students to learn creative and meaningful mathematics and to develop more robust mathematical identities. With funding from the National Science Foundation, I have worked with teachers over the past 6 years to develop their political knowledge and their propensity to take risks on behalf of students (Gutiérrez, 2013a). These teachers, many working in the inner city and teaching students who are Black[1], Latin@[2], historically looted[3] and/or emergent bilinguals[4], have learned to use an internal standard to measure their professionalism. That is, rather than look to external entities such as their students' scores on state tests, their own performance score on district mandated teacher evaluations, the number of district sanctioned professional development units, or "badges" given out by the Pearson Group for promoting the Common Core State Standards (National Governors Association, 2010), they look to the mirror and ask themselves if they are doing what they set out to do in teaching, something I call *The Mirror Test.* Guided by their ethics, these teachers have learned to be creative in the ways they talk and act with others in their work environments so that they are successful in advocating for youth and not simply dismissed.

Researchers studying school principals who resist bureaucratic policies and directives to protect

[1] I use the term Black to highlight the fact that many such students living in the US have ancestry in the Caribbean, South America, and Asia, among other places. Black students who attend schools and live in the US are racialized in similar ways, regardless of country of origin.

[2] I use the @ sign to indicate an intermingling of the "a" and "o" ending (Latina and Latino) partly to decenter the idea of a gender binary and to work against the patriarchal nature of the Spanish language where it is customary for groups of males (Latinos) and females (Latinas) to be written in the form that denotes only males (Latinos). The term is a sign of solidarity with individuals who identify as lesbian, gay, bisexual, transgender, questioning, and queer (LGBTQ). I use Latin@ instead of Latinx to privilege the oral language where Latin@ can be read as a diphthong, a gliding vowel.

[3] I use the term "historically looted" instead of "low income" to highlight the ongoing domination these students face and the benefits dominant members of society reap as a result.

[4] I use "emergent bilingual" instead of "English learner" both to decenter the idea that English should be the standard by which we measure students and to highlight that such students already have facility in at least one or more languages.

teachers have labeled this work Creative Insubordination (Crowson & Morris, 1985), a term that derives from activist circles in the 1980s where I first heard it. This article extends the early research on Creative Insubordination that focused on principals by connecting it with teachers and showing its usefulness in secondary mathematics (Gutiérrez, 2013a, b, 2015a, b; Gutiérrez et al., 2013; Gutiérrez & Gregson, 2013). With respect to mathematics teaching, Creative Insubordination includes the following acts: decentering the achievement gap; questioning the forms of mathematics presented in school; highlighting the humanity and uncertainty of mathematics; positioning students as authors of mathematics; and challenging deficit narratives about students of color.

Rather than blindly following district mandates or implicit policies, the teachers with whom we have worked hold themselves to a higher ethical standard for making their classrooms humane and meaningful for students. After studying their risk-taking (Gutiérrez, 2015d) and success, I categorized their effective practices into the following six strategies: Press for Explanation, Counter with Evidence, Use the Master's Tools, Seek Allies, Turn a Rational Issue into a Moral One, and Fly Under the Radar. I provide a brief description of each strategy and then highlight a few through further description and an example.

Strategies for Creative Insubordination

What follows are strategies for addressing political situations we face as mathematics teachers. I define political as any act that involves power dynamics, where one person uses their authority (real or perceived) to pressure others to conform to a particular norm. Everyday we use our authority to get students to conform to particular norms of classroom culture. Schools require us to start/stop our classes at a particular time. We assign homework and/or classwork that must be done in a particular amount of time. Many of these situations may already align with how we believe mathematics teaching and learning should occur. So, we do not think of them as political, though they are. However, when our work setting obstructs our goals and departs from the reasons we went into teaching in the first place, this causes tension and requires us to reflect on whether or not to take a risk in order to advocate for ourselves or for our students.

Not every political situation in mathematics teaching is a major confrontation. In fact, most are everyday events and comments, sometimes not even made to us directly. These comments can be so subtle and so much a part of what is considered "normal" conversation or practice, that they go unnoticed. These everyday events include: a derogatory comment about a student from a colleague or superior; a new policy that waters down the curriculum or undermines our previous success with students; a departmental structure that assigns the least experienced teachers to the most difficult classes; a nation-wide focus on standardized testing; or a comment made by one student to another that perpetuates the myth that some people are good at mathematics and others are not. Choosing an appropriate strategy requires we first recognize the kind of issue at stake (i.e., What power dynamics are operating? How does this issue relate to student learning and social justice?) and then consider the speaker(s), our relationship with them, and the context in which we find ourselves. These strategies are not a list of procedures to follow but rather examples of things that have worked for other teachers so as to inspire all of us. The strategies also are not meant to be distinct in the sense that only one is used at a time. In fact, combining two or more strategies can magnify their effects. Let us consider the strategies.

Press for Explanation

Whenever we are presented with a political situation, we may decide not to respond immediately and might simply press for explanation. For example, we may be surprised to hear a colleague undervalue a culturally relevant curriculum by stating, "Why do we have Black history month, anyhow?" Rather than attacking the speaker, Press for Explanation suggests we allow others to talk. We are essentially buying time. This strategy allows us to put the pressure on others to keep defending their points while we develop our counter-arguments. A couple of easy phrases to help buy time are: "Say more" or "I'm not sure I fully understand. Can you give me an example?" "Say more" is a great phrase because it does not indicate whether or not you agree with a statement; it invites further discussion without automatic defensiveness.

Counter with Evidence

When confronted with a representation of students or mathematics that seems harmful, a teacher might offer a different point of view. For example, we might be told by a superior, "These kids can't handle a more rigorous curriculum." We could ask ourselves: What evidence do I have that suggests a counter-narrative or opposing perspective? Do I have examples of students' work (e.g. assessments; classwork; homework) or instructional strategies I use in my classroom others say will never work (e.g. questioning strategies that elicit and build on student thinking)? When sharing these samples with others, it is important to highlight how they are not unique. Thus preventing them from being placed into "that's an exception" box. Rather than emphasizing how we are successful when others are not, it is generally more effective to focus on the contexts that allow students to prosper. In this way, we keep colleagues from feeling like we are making judgments about them personally.

Use the Master's Tools

Often, we are subjected to specific policies or constructs that confine us to doing things in ways that maintain the status quo of systemic power and privilege. These may be looked upon as the master's tools, the ways we are controlled (Lorde, 1984). However, we can flip this around and use these tools in ways they were not intended but that work to our advantage. We simply need to find ways to align written or oral statements of those in power with our goals. For example, if we are required to do "test prep" and we don't believe in taking away teaching time to do so, we might give students the answers first. Then have them work in groups to discuss how an individual could have gotten the "wrong" answers. This moves away from pressure to get the right answer; allows students to see how someone could have gotten both the correct answer (which emphasizes reasoning) and an incorrect answer (which encourages empathy for having assumed different mathematical assumptions); and shows how test companies intentionally create answers that are attractive distractors, helping students see that standardized tests aren't always the best measure of what one knows.

With Use the Master's Tools, we find ways to do what is in the best interest of our students and justify it with language that is valued in our schools or in professional documents. We can ask ourselves, can my work be seen as related to my "School Improvement Plan" or "Response to Intervention?" "Can I tie my work to the Common Core State Standards that asks teachers to develop a "Productive Disposition" in our students (Kilpatrick et al., 2001)?" This habitual inclination to see mathematics as sensible, useful, and worthwhile coupled with a belief in one's own efficacy relates more closely with "identity," as opposed to just looking to provide students with more "access" or "achievement" on four equity dimensions [5] I have elaborated on elsewhere (Gutiérrez, 2009). The overall focus is on recognizing that while the master's tools will never dismantle the master's house (Lorde, 1984), they can work to our advantage in the short term.

Seek Allies

This strategy suggests we find individuals who are more adept at certain practices than we are; people who know how to navigate our working context well; those who have been in our building longer than we have and who, for reasons such as lived experiences or sustained commitment, have gained the trust of students or administrators; and ask for their advice. It's much easier for us to convince others of something if we have a critical mass of people to echo our views. Often times, we only need 1-2 other people to accomplish something. For example, we can rely on our colleagues to restate our points/concerns during faculty meetings so that the burden does not fall completely on our shoulders. This is especially important for newer teachers. If planning to rely on others in a meeting, it is helpful to have a "pre-meeting" to decide who will say what and to anticipate the kinds of opposition that can arise.

Turn a Rational Issue into a Moral One

This strategy asks us to turn the conversation into one that highlights our moral character and that of those

[5] The four dimensions of equity are: Access, Achievement, Identity, and Power.

around us. This is useful when logic doesn't work and when all of our arguments, data, and reasons to consider a different option fall on deaf ears. It also works well in public settings because nobody wants to look bad on a moral issue. The focus is on convincing people to "do the right thing," an effective strategy that activists have used for decades. Some language to consider is, "Regardless of what the data suggest or what has been done in the past, is this what we want to *stand* for (or be remembered by) as a department/team /school/teachers?" The inverse of this strategy is to use privilege, instead of morals, turning the conversation into one that puts our colleagues in a position of power. This strategy appeals to those who care less about ethics and are more ego-driven. Helpful language includes, "That's what we're being *told* to do, but *leaders* are not rule followers."

Fly Under the Radar

Sometimes the aforementioned strategies just do not apply to our situation. The risk is too high or the likelihood of even being noticed for challenging the status quo is minimal. In that case, we might decide to just do what is in the best interest of students and not let others know until we have a track record of success. This strategy is useful for having our students work in groups when no one in our department does; trying out a new homework policy in a class; instituting a creative hands-on mathematics activity that uses the body or otherwise challenges the notion that doing mathematics only requires a brain and technology (e.g., paper and pencil; computer); doing a monthly social justice mathematics activity; or having student leadership teams that inform our teaching. The motto to this strategy is *Ask for forgiveness, not permission*. The key is to eventually share what we have been doing once we can document its success.

Creative Insubordination in Practice

Let's take those strategies and apply them to a political situation that a mathematics teacher faced. Mr. Ramirez' high school had been successful with their predominantly Latin@ student population, many of which had Spanish as the language they spoke at home. Mr. Ramirez and his colleagues were convinced that part of their success was due to using the Interactive Mathematics Program (IMP) curriculum (Alper et al., 1997). Their students had learned to work well in groups; they were communicating their mathematical ideas in Spanish and English; and were comfortable coming to the board to explain their work and to justify why it made sense. Yet, the school district decided to stop using IMP, preferring a curriculum that, in their eyes, better prepared students for standardized tests by focusing on basic skills and ample amounts of practice problems. Instead of just accepting this new policy, Mr. Ramirez and several of his colleagues decided to stand up to administrators. They met regularly to decide how best to respond in a professional manner. Seeing that their district highly valued the idea of "data-driven decision making," they offered to be the "control case" for the district. That is, while other schools stopped using IMP, they would continue to use it and the district could compare their students' results with the results of other schools that moved to a basic skills curriculum. Beyond the typical test scores collected by the school, the mathematics department also collected data on how their students were doing in their courses to show that widespread student engagement and the ability to work with others to explain their answers were outcomes of their teaching.

This approach begins with Seek Allies but then focuses deeply on Use the Master's Tools and a bit of Counter with Evidence. By meeting together to brainstorm how they would approach their situation and using language and practices that were valued by the district ("data driven decision making" and "control case"), they positioned themselves not in opposition, but in alignment with the overall goals of administrators. In this respect, they kept from being easily dismissed. Although IMP was eventually eliminated from their school, the strategy of Use the Master's Tools bought them a few more years of using the curriculum they wanted. During that time, they also recruited some newer teachers into the school who wanted to teach with IMP. These newer teachers shared the department's commitment to students; their work today reflects many of the principles they feel supported students— getting them to work with each other, valuing students' home language, focusing on conceptual not just procedural understanding, and having students present their work to the class. So, while Mr. Ramirez and his colleagues lost the battle over the specific curriculum used, they won another important battle: increasing the amount

of teachers in their department who were committed to advancing historically marginalized students in mathematics. Seeking Allies and Using the Master's Tools aided their long-term vision to reclaim mathematics teaching in ways that were consistent with their shared belief that learning could not be captured by test scores alone.

What Keeps Teachers from Using Creative Insubordination?

If these practices of Creative Insubordination are so useful, why aren't more teachers using them? The answer is complex. On the one hand, many teachers, especially newer ones, fear retribution. For them, the insubordination part sounds like grounds for being fired. Insubordination of any kind may not align with the implicit message of what it means to be a professional given in many teacher education programs (Gutiérrez, 2015a). Rather than developing a critical eye on new initiatives, professional development often unwittingly exposes teachers to what I call Weapons of Mass Distraction [e.g., understanding and employing the Common Core State Standards, developing in students a "growth mindset" (Dweck, 2006) or "grit" (Duckworth, 2016), closing the achievement gap, or using more technology in the classroom]. While these reforms are worthwhile goals, they can distract teachers from being able to recognize the structural or systemic problems that lie at the heart of meaningful learning. In order to be professionals, teachers need to understand the strengths and limitations of new initiatives. In this respect, teachers may be underprepared to do Creative Insubordination because they lack the tools or opportunities to carry out critical analyses. They might not understand how a focus on "grit" or "growth mindset" is highly cognitive, places the burden of change on the individual, and fails to interrogate institutional structures/practices that disadvantage students of color in schools (Ferlazzo, 2015; Kohn, 2015). Moreover, some teachers may feel they do not know how to talk about important issues that arise in political situations (e.g., racism, classism, politics of language, history of mathematics). Learning the kind of language practices that encourage dialogue and joint problem solving rather than conflict or defensiveness is important in this endeavor. See for example, Gutiérrez (2014) for a more extensive discussion of the types of phrases and language strategies that are useful in Creative Insubordination. And, finally, some teachers may view these practices to be the work of assertive, charismatic, or more veteran teachers. Yet, teachers with very different personalities and even pre-service teachers have successfully used these strategies (Gregson & Bradley-Harris, 2015; Gutierrez, 2013a, b; 2015c). Some teachers may feel this kind of work seems too battle-oriented or the work of "trouble makers." However, with public education, teacher education, and teachers all under attack, strategies for Creative Insubordination are often necessary to reclaim the profession. Moreover, these strategies are only a small list of the kinds of things teachers can do. All of us need to find ways of owning this work and putting our own mark on it.

Learning about these strategies might make us want to start a dialogue with members of our math department, team, or group of like-minded teachers across our district or city. Here's one activity to try on a regular basis to help rehearse for the political nature of mathematics teaching. It is called, "In My Shoes" (Gutiérrez, Gerardo, & Vargas, in preparation). In it, one teacher presents a scenario they have faced and others respond with questions and eventually what they might do if they had been in the presenter's shoes. In the beginning, the presenter simply states the scenario they faced without giving details about what, if anything, they did in the situation. If the presenter is still able to influence the outcomes of the event, then it would be good to have the presenter practice saying/doing what they would like. This might be the case for a controversial policy that will be discussed at an upcoming meeting or a disturbing comment that was made by a student or colleague. If the scenario is one where the window of action has already passed or where the individual was happy with how she responded, we might have another individual in the group take on the role of the teacher during role play. Others in the group can then serve as devil's advocates by responding in ways that do not simply go along with the teacher's suggestions. In these situations, others in the group should practice trying to come up with ways to stump the teacher. For example, if one of us has faced a colleague who has deficit views about particular kinds of students, we might practice using Counter with Evidence or Press for Explanation while others in the group might try to continue to show how those examples are simply exception cases. With role plays we get the chance to

practice saying what we think we would do. In my interactions with teachers, it can be easy to offer advice or summarize what we might do in a given situation. But, having the words come out of our mouths and feeling how nervous we are or how much we did not anticipate the kind of response we are receiving is completely different. Creative Insubordination requires that we think like a chess player. That is, we cannot just think of our first move; we need to be thinking of all of the successive moves. "If I do/say this, what are they likely to do/say in response? And then, what is my next move?" Role plays and discussions with like-minded individuals can go a long way towards helping us anticipate the kinds of stumbling blocks we might hit and can further engrain our resolve to say/do something about the situation, either this time or the next.

Lessons Learned

In choosing to use Creative Insubordination, we are refusing the status quo when it is not in the best interest of our students. This means questioning some of the typical norms in mathematics teaching and learning. An important step in this work is first deconstructing what is going on around us, making the "normal" seem abnormal. For example, do we notice that the students in our calculus classes do not represent the demographics of our school? Only then can we imagine and plan for a different possible future where that representation is present.

Teaching mathematics involves negotiating one's practice with colleagues, parents, administrators, students, and at times, community members. Choosing to refuse the status quo is an important option for maintaining our sense of morals, especially given the fact that we will never please all of the aforementioned constituents at the same time. Having political clarity on why we are doing the things we do is important (Beauboeuf-Lafontant, 1999).

I have learned a number of things in helping mathematics teachers develop their Creative Insubordination practices in our current context of high stakes education. First, political knowledge for teaching, including understanding that all decisions are political acts, is as critical as other forms of knowledge that are normally touted as important for teachers to develop (e.g., Pedagogical Content Knowledge, Mathematical Knowledge for Teaching). Second, Creative Insubordination recognizes that teaching involves training for a marathon, not a sprint. That is, the work of teaching and its effects on students must be developed over time and measured over years, not days. So, focusing on only one or a few things and doing them well is more likely to keep us attentive to the needs of our particular students and our working context and also keep us from burning out on teaching.

For many of the teachers I have worked with, acts of Creative Insubordination are critical for advocating for marginalized students such as emergent bilinguals, students who are Latin@, Black, American Indian, or historically looted because the system is not set up to protect them. However, Creative Insubordination is applicable to <u>all</u> students and is best done as a collaborative and intergenerational approach. That is, when teachers come together in powerful collectives; we can share the workload; buffer each other from attack; inform others of our experiences so individual teachers do not need to reinvent the wheel; and serve as a support network and a reminder for the kind of ethical work that is important in our profession. In considering the kinds of risks this work requires and the rationales that effective teachers use to support such risk taking, they seem to be following the saying, "We act ourselves into new ways of thinking, not the reverse." That is, much of this work requires deconstruction (unpacking the micro and macro issues that may be hidden in dominant practices) and deep reflection (knowing which principles we stand for). But more importantly, Creative Insubordination requires <u>action</u> on the part of teachers. Our actions, often leaps of faith, can lead to changes in how we think about a given situation in teaching. Luckily, learning how to advocate for our students can help us better advocate for ourselves (e.g., the right to have teacher collaboratives or common planning time). As teachers, we need to continue to look ourselves in the mirror each day and ask, "Am I doing what I said I would do in education when I entered this profession? And, if not, what am I planning to do about that?"

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In Memoriam: Cathy Kinzer

Dr. Cathy Kinzer, leading mathematics educator, and cherished friend and colleague, died in a tragic auto accident while traveling to her beloved ranch in rural New Mexico from her home in Las Cruces. Cathy was an Associate Professor of Mathematics Education in the Department of Curriculum and Instruction at New Mexico State University (NMSU). Described by many as a "lovely person", Cathy was a very genuine collaborator who brought people together and worked tirelessly for the children and teachers of New Mexico.

Born in Carlsbad, New Mexico, and raised on a ranch near there, Cathy earned three degrees at NMSU: a B.S. in Biology, a Masters of Arts in Teaching Mathematics and a doctorate in Curriculum and Instruction with a specialization in Mathematics Education. Her early teaching experience was at Mesilla Park Elementary School in Las Cruces for which she was awarded the national Presidential Award for Excellence in Mathematics and Science Teaching by the National Science Foundation (NSF), after having been named by the New Mexico Academy of Science as an Outstanding Elementary Science Teacher.

Recognized for her leadership abilities, NMSU hired her part-time and in summers to teach Mathematics Methods courses and work with the NSF-funded Collaborative for Excellence in Teacher Preparation. She was brought on board full time at NMSU in 2001 and served as mathematics education specialist for the NSF-funded Gadsden Mathematics Initiative and the US Department of Education-funded MathStar Lesson Study Project. She was appointed an Assistant Professor at NMSU in 2007 and promoted to Associate Professor in 2013. Her current outreach and research projects included: serving as a lead mathematics educator for the NMSU - Mathematically Connected Communities (MC^2) Project, funded by U.S. Department of Education Math/Science Partnership Program (MSP) and the NM Public Education Department (PED); PI/Project Director of the MC^2 Teacher Leader Cadre, funded by New Mexico Higher Education Department; and lead researcher on MC^2/Las Cruces Public Schools study of Early Childhood Identity and Agency in Mathematics.

In her too short time as a faculty member at NMSU she three times won the Million Dollar Research Award, as well as the Dean's Award for Excellence in Teaching, and the Alliance for Minority Participation's Recognition of Research Award. She was the Program Coordinator for a partnership with the Los Alamos National Lab (LANL) of a Masters of Arts in Teaching Mathematics and Science for which LANL awarded her a special Recognition for Support of their Math and Science Academy (MSA).

At the state level, Cathy was a Past-President of the New Mexico Council of Teachers of Mathematics and served as their representative to the National Council of Teachers of Mathematics (NCTM). She served the Public Education Department as a member of the Math and Science Advisory Council, as the Mathematics Lead for the Educator Leader Cadre, as well as an active participant on committees that developed Standards for students and teachers. She facilitated professional learning experiences for and with teachers and administrators throughout the state.

At the national level, NCTM recognized Cathy's abilities and passions by appointing her to their Emerging Issues Committee for which she had recently assumed the chair. She was a member of various committees for NSF, TODOS-Mathematics for All and other organizations. She was a reviewer for many organizations and publications.

Cathy's experience in teaching, service and research is well represented in dozens of publications, often written in collaboration with colleagues. Throughout her publications her dedication to improving the mathematics education of diverse learners can be witnessed.

Her family has established a scholarship fund at NMSU in order that Cathy's passion continue on in future educators. Those wishing to contribute can go to the following link: http://giving.nmsu.edu/CathyKinzer.html

Submitted by Claudia Ahlstrom, Wanda Bulger-Tamez, and Patrick Scott

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