Journal of Urban Mathematics Education
July 2013, Vol. 6, No. 1, pp. 71–80

Considering the Social Justice Mathematical Journey of Secondary Mathematics Preservice Teachers

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In this essay, the authors share some of their journey as they seek to make sense of what it might mean to prepare secondary mathematics preservice teachers to teach mathematics for social justice. The focus on how to prepare mathematics teachers to critically consider the world around them and to further develop the dispositions to become agents of change has been discussed in the research literature. What it might "look like" to enact this type of programmatic-level teaching at a college or university, however, has rarely been examined. Through the sharing of their thoughts and reflections, the authors hope others might draw inspiration to reconsider the teaching of mathematics courses for social justice at the program level.

KEYWORDS: mathematics, mathematics teaching, preservice teachers, social justice

Seven of us sat around the room in a circle formation. We had gathered for the first meeting of our teaching circle that was funded by the University's Center for Teaching and Learning as a venue for professional development. All the members of the teaching circle were instructors within the mathematics department in some capacity: four mathematicians, two mathematics educators, and one retired high school teacher. During this meeting, we brainstormed which qualities we wanted our secondary mathematics preservice teachers (PSTs) to possess upon graduation from our program. "We want teachers who can teach to a diverse population of students," was one professor's response.

As participants in that teaching circle, we held the philosophy (and still do) that effective teaching of mathematics to a diverse population of students must allow students to use mathematics to "examine one's own lives and other's lives in relationship to sociopolitical and cultural-historical contexts" (Gutstein, 2006, p. 5). The focus on how to prepare mathematics teachers to critically consider the

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world around them and to further develop their dispositions to become agents of change is one that has been discussed in research (e.g., de Freitas & Zolkower, 2009), this is what we refer to as teaching mathematics for social justice. Yet, until these teaching circle meetings, neither of us (Laura and Joyce) had really considered what it might "look like" to enact this type of programmatic-level teaching at the university level. As the conversations within the teaching circle continued, we wondered such questions as: What would it look like to teach collegiate-level mathematics content courses through a lens of social justice? Do we as mathematics instructors possess the necessary knowledge to teach mathematics in this manner?

The purpose of this essay is to share some of our journey as we seek to make sense of what it might mean to prepare secondary mathematics PSTs to teach mathematics for social justice within our institution. Our hope is that through the sharing of our honest thoughts and reflections, other individuals can begin to clarify their own thinking or draw inspiration to reconsider the teaching of mathematics courses within their own teacher preparation programs.

Our Journeys

It is important to situate our backgrounds within our work. As Foote and Bartell (2011) argue, our life experiences shape what we attend to in our work, including the questions we ask and the interpretations we draw.

Laura: Growing up, I didn't know that I led a privileged life, as I realize that I wore blinders towards the consideration of inequities that existed within society. I lived in a middle class, white community where racial, ethnic, and socio-economic diversity were practically non-existent. While both my mom and dad worked to support us, my family never went without. I grew up in a nice home, and we always had food on the table. From my viewpoint, people looked like me and shared the same values and norms as my family.

Joyce: I grew up during the turbulent 60s, a period when the issues of social injustice and inequalities were constantly in the news and on the forefront of many people's mind. These events shaped my young mind while living with my family in a working class urban community. Early in school, I discovered that I had a love for mathematics, and I often found myself in classes where using arithmetic and algorithms were expected. I was one of the first girls to be permitted in a drafting class, and I honed my skills with fractions in home economics. As an African American, I was intimately aware of the disparities of high unemployment, low quality schools, and high crime that existed within my community. This con-

sistent awareness facilitated my evolution as a teacher and my drive to promote equality within society for all people.

Laura and Joyce: We both excelled as mathematics students, at the K–12 and collegiate levels alike, having learned how to navigate the school environment. Through past experiences, we learned how to create a teacher-centered environment within a "banking concept of education" (Freire, 1970/2000, p. 72): lecture, require students to take notes, maintain a limited amount of engagement, and assess learning. These experiences, however, were challenged for each of us as we took high school teaching positions in low-income urban areas with students whose lived realities were very different from our own. We saw that our teacher-centered lectures, even coupled with some cooperative learning activities, did not help our students succeed in a traditional sense. We realized that the problem lay not with the students, but with how we were approaching mathematics teaching, yet were unsure of how to change. With a need to know, we each moved on from teaching secondary school mathematics to pursuing doctoral degrees in education.

Laura: I was fortunate to be a Fellow in the Center for the Mathematics Education of Latinos/as (CEMELA[1]) throughout my doctoral program. It was through CEMELA that I was exposed to theories and frameworks surrounding issues of social justice, specifically from a Freirian paradigm of critical pedagogy (cf. Freire, 1970/2000). Initially, I was resistant, as I felt overwhelmed considering this new paradigm, as well as defensive about the subject at which I had so excelled in school. Over time, however, I began to connect what I was learning with the experiences I had had as a high school mathematics teacher and the quest I had to help *all* students be successful in mathematics.

After completing my doctoral program and taking a tenure-track position at a university, I was invited to participate in the Privilege and Oppression in the Mathematics Preparation of Teacher Educators (PrOMPTE[2]) conference. Throughout the conference, I explored and grappled with issues of privilege and oppression within my own life. Further, I reflected upon these constructs within my own teaching and how I work with future secondary mathematics teachers.

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[1] CEMELA is a Center for Learning and Teaching supported by the National Science Foundation, grant number ESI-0424983. Any opinions, findings, and conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the National Science Foundation.

[2] Privilege and Oppression in the Mathematics Preparation of Teacher Educators (PrOMPTE) conference (funded by CREATE for STEM Institute through the Lappan-Phillips-Fitzgerald CMP 2 Innovation Grant program), Michigan State University, Battle Creek, MI, October 2012. Any opinions, findings, and conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the funding agency.

Joyce: In my graduate experience, I continued to cultivate and nurture the "mission" for social justice that was already growing inside of me. I was a child and adolescent during the Civil Rights era. It was during these years that I was exposed to the philosophies of such activists as Septima Clark, Ella Baker, and Kwame Toure (Stokely Carmichael). The voices of these activists influenced my viewpoint and convinced me that it is within the power of the grassroots (common people) to make the world a more humane place for all people. While in graduate school, I was able to merge the philosophies of the activists of my youth with the philosophies of such critical pedagogues and scholars as Paulo Freire, Henry Giroux, Peter McLaren, and bell hooks. It is this marriage of philosophies that shape my current thoughts and pedagogy around mathematics education.

Moving Forward

Each of our journeys has led us to our current location: Flint, Michigan. Flint is a community that has attracted the nation's attention for various reasons over the last few decades. The city is struggling with emergency financial takeover by the state, high unemployment rates, high crime rates, and closing schools. It is a city that is ripe for community transformation, and this transformation could be facilitated through the vehicle of education. It is in this place where we engage university students as faculty members of a mathematics department (Laura, a tenure-track assistant professor; Joyce, a lecturer). Here, we wish to prepare secondary mathematics PSTs to integrate issues of equity and social justice throughout their instruction.

Through our ongoing efforts in our one-semester mathematics methods course, we are making strides to challenge perceptions of what it means to teach and learn mathematics. We realize that our efforts will most likely be the first opportunity for most, if not all, of our PSTs to question their own views regarding mathematics and its potential as a vehicle to critically challenge the world. Ideally, we would like our course to be a space in which PSTs see themselves as agents of change within the educational system and as such develop and acquire strategies that they can put into action in their own mathematics instruction. In order to achieve this ideal, though, we posit that PSTs need to experience social justice as a cornerstone of mathematics teaching throughout their mathematical career. With this in mind, logistical questions arise. Some of these questions include:

- Should all college-level mathematics courses be taught through a lens of social justice? If not, which ones should be?
- What would a curriculum that uses social justice as its basis look like in a college-level mathematics course? What would a program of study that

uses social justice as a basis look like (i.e., sequencing, textbooks, course goals, assessments, etc.)?

- What knowledge would be necessary for mathematics teacher educators in order to instruct in this manner? Do we possess this knowledge, and if not, how do we obtain it?
- How do we prepare both students and colleagues for this paradigm shift in teaching and learning? How do we address resistance from colleagues and/or teachers?
- Do we have the courage to teach these courses outside the scripted norm? Are we secure enough in our own constitution (and positions) to undertake this journey?

A Dialogue

In this section, we recount some portions of our ongoing conversation[3] in an effort to grapple with one of these big questions, namely, *Should all college-level mathematics courses be taught through a lens of social justice? If not, which ones should be?* Through our dialogue, it is possible to see how our thinking diverged, but ultimately converged when we began to focus on a specific entry point for our PSTs to begin a mathematical journey focused on social justice.

Laura: Should all mathematics classes that our PSTs take be taught through a lens of social justice? That's a difficult question. For one, I'm not sure I have the necessary knowledge to teach, for example, an abstract algebra course in this manner, as my schooling experience had me focus on acquiring a classical knowledge of mathematics (Gutstein, 2006). Specifically, I would have a hard time relating the content to issues of social justice. For example, how would I teach concepts such as unique factorization domains through a lens of social justice? And more importantly, should we? We need to consider what the goals are of such a course: Why are PSTs taking this course? What purpose does it serve for their preparation? Then we need to see how those goals align with the goals of a course that has social justice as its focus. Perhaps it doesn't make sense for our PSTs to have *all* of their mathematics courses be taught through a lens of social justice, especially if the goals of the class are mutually exclusive from the goals of a class with social justice as a focus?

Joyce: If students experience the foundations of mathematics (such as functions) through a social justice lens throughout their mathematics career, then they would

[3] The dialogue presented does not represent a transcribed conversation as grammatical edits have been made since the conversation took place.

infuse these "higher-level" mathematics courses with the social justice perspectives themselves. The proverb "if you give a man a fish, he will eat for a day, but if you teach him how to fish, he will eat for a lifetime" comes to mind. If I can expose students to social justice perspectives of mathematics early in their mathematical careers, then I believe that they will have the tools to shape mathematics for themselves into instruments of social justice whenever they encounter mathematics.

Laura: It seems that you might be saying that the students will integrate issues of social justice regardless of how we teach college mathematics courses, as long as we teach earlier mathematics courses through a social justice lens. If so, I'm not sure I agree. Some of the mathematics courses at the college level (e.g., Abstract Algebra, Complex Analysis) are very different than the ones they experience earlier on in their mathematical careers (e.g., Algebra I, Geometry) in their direct application to phenomena within the world. So, while PSTs can know how to view certain ideas in mathematics through the lens of social justice (such as factoring real numbers), they might not be able to transfer it to more abstract mathematical concepts (such as factoring over fields other than the real numbers). But I do agree that early exposure is an important and essential component in students' mathematical lives. With this exposure, PSTs may think to question how the higher-level abstract mathematical concepts in their later mathematics courses can be used to see, read, and write the world (Gutstein, 2006), and thus, hopefully be able to guide their future secondary students to do the same.

I still question what the goals are of some of the collegiate mathematics courses. In conversations with some mathematicians, they seem to be of the mindset that mathematical concepts do not always have to be directly applicable to context—that there is value in studying mathematics for the inherent beauty of the discipline. If these are the goals of some of the mathematics courses that PSTs are taking and if teaching mathematics through a lens of social justice means that social justice is an integral and authentic part of the mathematics course, perhaps we will do more harm than good if we try to "force" issues of social justice into a mathematics course when the issues are less authentic to the nature of the subject.

Let me be clear… I am not saying that there is no place for issues of social justice in higher-level mathematics courses. We just need to integrate the issues in such a way that is authentic to the content of the course.

Joyce: Let me back up… I need to revisit this big question: Should all mathematics courses be taught through a social justice lens? Let me use art as an analogy. There are aspects of art that I learn because I am interested in learning to improve my creativity. But then there are aspects of art that are beautiful and I would like to learn simply for the appreciation of art. So, speaking of mathematics now, the

question for me becomes whether all mathematics is utilitarian? Or are there parts of mathematics that are for pure beauty and appreciation? I think each question has its own answer. We know that there are mathematics courses that we teach for utility, in other words, to enhance students' abilities to solve problems. We refer to those courses as *applied* mathematics, while the courses that we teach for appreciation and beauty, of course, we refer to as *pure* mathematics. With these definitions in mind, shaping a course around the issues of social justice in a collegiate-level mathematics curriculum definitely creates a conundrum. As we think about issues of social justice, we may find it easier to pose problems of inequity or societal challenges that could easily align with the applied aspects of collegiate mathematics. It's only when we attempt to imagine a framework to hang issues of social justice on from the pure aspects of mathematics that we begin to feel like we are bumping our heads against the wall. For me, issues of social justice are issues of the heart. It can reasonably be assumed that it is not simply the act of "examining" their lives and the lives of others that we want our students to experience, but rather an attempt to facilitate a raising of the consciousness of their life experiences in relationship to others. So if it is essentially affecting the heart that we are looking to achieve, then it would seem that pure science and social justice have much in common given that both attempt to provide an experience of the heart—one in appreciation and the other in valuing others.

Laura: I would argue that mathematics is historically taught free from context, and that because of this lack of contextualization, mathematics tends to attract a type of student who has a particular disposition towards not considering mathematics as a venue for issues of social justice. I agree, then, that we are affecting the heart, where we want our students to develop a disposition towards the world to view mathematics in light of issues of social justice. I believe that integration of social justice issues into the curriculum is key, as it may seem, upon first glance, that only certain courses can be taught through a lens of social justice. With that said, one could argue that a more natural fit of teaching through a lens of social justice would be the earlier level courses (earlier in the PSTs' mathematics journey I mean), that is, the Calculus sequence and Linear Algebra. I say this because these courses seem to have content that directly aligns with scenarios which individuals can encounter in their lives (e.g., rates of change in Calculus; engineering concepts in Linear Algebra). This content also directly aligns to what the PSTs may teach in secondary schools.

Joyce: Well, I believe that we must wrestle with the question of where to begin our PSTs' experience of mathematics from a social justice lens. As a lecturer, my experience has been teaching mathematics to students who are novices in their mathematical journey. In fact, these courses are similar to the level of mathematics that the majority of PSTs will teach in schools. I feel that it is at this level of

mathematics education (Intermediate Algebra, College Algebra, Pre-calculus, and, perhaps, Calculus I) that students need to have the experience of learning mathematics from a social justice lens. For the PSTs who start their mathematical careers in these earlier classes, they would have as a point of reference those experiences in the mathematics courses that are taught from a social justice lens. These earlier experiences could have a positive impact on mathematics methods courses, in that less time would need to be spent on the introduction of this ideology and more time could be devoted to the methodology of creating lessons for social justice prior to a student teaching field experience. Yet, thinking about how to instruct Abstract Algebra from a social justice lens leaves me perplexed. However, I do feel that drawing from the tenets of ethnomathematics (D'Ambrosio, 1985) and showing how mathematics of this caliber was/has been discovered and used in non-Western societies and that elements of these mathematical concepts had their genesis with these diverse groups would benefit PSTs greatly.

Laura: I agree that we need to teach the courses you mention through a lens of social justice, but we still need to consider what mathematics courses our PSTs would take. I'm not sure that a lot of our PSTs would start at the levels you mentioned … well, maybe Calculus I. So perhaps we could just focus on what curriculum would look like for a Calculus I course. And then maybe, as you said earlier, if we provide our PSTs social justice mathematics opportunities early in their program, they could begin to develop the disposition to question and challenge how social justice fits within their the mathematics classes later in their mathematical journey.

Joyce: Reminiscing on my experience as a preservice teacher taking mathematics courses, I actually began my coursework with Pre-calculus; that is why I suggested beginning with those specific earlier courses. However, I think that Pre-calculus and/or Calculus I could be a good place to start our work. Another option might be to undertake a mission of sorts, to have the students of higher-level mathematics courses (as part of course requirements) create their own projects for social justice that utilize~~s~~ mathematical concepts. At the very least, we could create an upper-level mathematics course that could be offered as an elective, in which the primary focus would consist of developing mathematical models for social justice. Doing so would "kill two birds with one stone:" students could discover for themselves how to link social justice to the mathematical concepts taught, and we could collect a repertoire of instructional materials to incorporate in future courses or even refine for other courses.

I am all in favor of developing a social justice curriculum for Calculus I. Another thought: What about creating an interdisciplinary course, partnering with colleagues in the sociology department for example, that would be eligible for

general education credit? The purpose of this course could be to look at critical social problems and current challenges (be it, political, social, economic…national and global) and to create mathematical models and develop sociological paths towards solutions to these problems from a grassroots perspective.

Reflection

As professionals who believe that our job is to change the paradigm of teaching and learning mathematics, it is clear throughout our conversation that we are grappling with what courses should be included in our PSTs' mathematical journey to help them become agents of change, and further where to begin this journey. We started the conversation from different perspectives, each taking into account the level of mathematics that we teach. Upon reflection, though, this difference is not surprising given that the merging of a variety of viewpoints is, at its core, a communication one. However, we find numerous strengths in our communication. First, we were not afraid to start a dialogue around a difficult question, although we didn't know where it would lead. Second, all the thoughts and contributions put forth were not only valued but also respectfully challenged. Finally, the conversation continued to evolve and develop until both of us were standing on (or somewhere close to) mutual ground.

While our conversation regarding the instruction of *all* college-level mathematics courses is still ongoing, the process of sharing our thoughts helped us identify a starting point for how we could begin to integrate social justice into the mathematical journey of our PSTs. More importantly, our dialogue served as a springboard to move us forward from theory to reality. Using others' work as a starting point (e.g., Staples, 2005), we are now working on the design of a Calculus I course that focuses primarily on issues of social justice. This beginning is an important implication as this is new territory for us; one we have not travelled before and do not have a prescribed template from which to work. However, we now understand that we cannot have answers to all our questions before we jump in to this uncertain domain. Although the fear of not possessing the "right" knowledge is very much a reality for us, in order to help our PSTs rethink mathematics—and in order for us to rethink mathematics ourselves—we realize that we must take a leap. We hope that others who are also considering challenging the purpose of collegiate mathematics teaching and learning will take the leap with us, and that we can learn from each other.

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