

Math for Social Justice in a Prospective Teacher Content Course: Increasing Engagement and Developing Political *Conocimiento*

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Abstract: There is a well-established need for prospective elementary teachers (PTs) to develop a deeper understanding of mathematics before they begin teaching, but PTs often see math content courses as remedial or review. I report here on the early stages of a multi-year course design project that intends to motivate PTs to engage with mathematical content by leveraging the context of high-stakes, political systems they will navigate in their future roles as teachers.

Motivating preservice elementary teachers to engage with mathematics

Research has shown that most prospective elementary teachers (PTs) enter teacher preparation programs with relatively shallow, procedural understandings of mathematics, rather than the deeper, conceptual understandings needed for teaching (Thanheiser, Browning, Edson, Lo, Whitacre, Olanoff, & Morton, 2014). Math content courses for PTs attempt to deepen understanding and broaden PTs' conceptions of mathematics. Unfortunately, because these courses involve relearning mathematics previously learned in a procedural manner, PTs often believe the courses are review and may not engage at a deep level (Zazkis, 2011). Shilling-Traina and Stylianides (2013) addressed this issue by incorporating "pedagogy-related mathematics tasks" that involved PTs in exploring mathematical content and situated that content in a pedagogical context. In a small pilot study, I attempted a similar strategy by situating the study of percentages in the context of classroom grading systems. Subsequent assessment, however, showed that while most of the PTs mastered the relevant procedural calculations, they were unable to discuss the potential consequences of grading system differences on a conceptual level. It seemed that although PTs were motivated by a context they saw as relevant to teaching, their lack of practical experience meant that an activity based on an authentic challenge faced by teachers manifested as a mediocre story problem. It became clear that designing activities to engage PTs in quantitative critical thinking and conceptual problem solving around complex, teacher-relevant, real-world problems would require theoretically-grounded design principles (Kali, 2008) that could then be tested in the classroom.

Using theoretical frameworks to develop design principles

I have drawn from critical theory and socio-cultural theory in math education to develop such design principles. Gutstein's (2012) description of using social justice contexts to teach math to high school students parallels my goals for and challenges with PTs, so I drew from his Freirean framework of critical pedagogy to inform my design principles. Gutiérrez's (2017) theory of political *conocimiento*—situated knowledge that teachers need to navigate politically-charged systems in education—provided a powerful description of the type of knowledge PTs lack and why they need to develop it. Gutiérrez's (2012) work on fostering *conocimiento* in PTs therefore provided a second theoretical framework to inform the design principles. While Gutiérrez works with PTs who are studying to teach high school mathematics and are likely to have productive mathematical dispositions, the elementary PTs I work with are often uncomfortable with math and may need additional support to think critically about the quantitative aspects of political systems in education. Gresalfi and Cobb's (2006) work on cultivating productive math dispositions serves as a complimentary framework to inform design by describing how to support PTs' mathematical autonomy and authority—key goals for both broadening their understanding of mathematics and increasing their ability to apply their critical quantitative skills in their future teaching career. All of these frameworks shared a focus on collaborative learning and discussion, critical thinking, and student (in this case PT) autonomy, which supported the creation of a coherent list of core design principles:

1. Select an authentic context from teacher practice that connects the mathematical, the personal, and the political.
2. Require PTs to set priorities, evaluate results, and justify their mathematical choices to their peers.
3. Require PTs to plan and execute their own methods of mathematical exploration and evaluation.
4. Stimulate discussion and reflection on situations that entail conflicting truths with tools that support (quantitative) comparison of alternative possible realities.

These design principles are currently being used to plan a series of activities to teach math for social justice and political *conocimiento* in a math content course for PTs. After small-group pilot testing and design

adjustments, the activities will be implemented in a whole-class context in Fall of 2020. In the remaining space I will briefly describe the current design for one of the activities and how it instantiates each of the design principles.

Using the design principles to create an activity around school rating systems

The proposed activity will focus on the context of a high-stakes school rating system. The system uses a combination of measures with a focus on standardized test results to assign schools numerical ratings. Students and families use the system to select schools and district administrators use it to assign resources and close schools. PTs may be familiar with the rating system from their own schooling; as teachers they will likely experience pressure to maintain or increase their school's scores and parent and student requests for advice about school selection (Principle 1). The activity will begin with PTs reflecting on their beliefs about what makes a good school and relating them to the components of the existing rating system (Principles 1 & 2). They will then work in small groups to develop alternative rating systems and discuss what it means for a rating system to be good (Principles 2 & 3). Next, PTs will use the School Rating System Dashboard (Figure 1) to compare their proposed system with the current system using maps and bar charts showing the distribution of schools in each rating category (Principle 4). PTs will adjust their proposed rating systems until they are satisfied and then share their proposed systems and strategies for evaluating them (Principle 4). The class will discuss the affordances and limitations of different procedures for comparing distributions, including across unequal populations (Principle 4). Finally, PTs will modify their proposed systems and reflect on their beliefs about what makes a good school (Principles 1, 2, & 4).

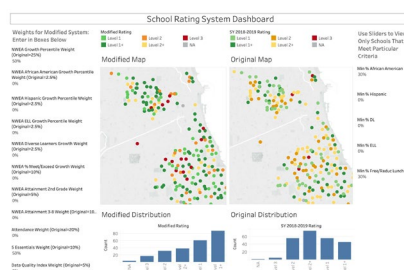


Figure 1. The School Rating System Dashboard compares official and PT-proposed rating system results.

This work is still in early stages, but using teacher-relevant math for social justice pedagogy to engage PTs in a math content course has potential to lay the groundwork for changes in PTs' beliefs about mathematics that can then be built upon in methods classes. It will hopefully also help prepare PTs to engage with high-stakes, quantitative systems when they become teachers. These design principles and this proposed activity design are an important first step for creating that change.

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