"This is a Problem for the Entire Nation, Not Just My Mom": Poverty and Homelessness in a Mathematics Course for Preservice K-8 Teachers

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Public schools in the United States are becoming increasingly diverse, requiring a teaching force that is responsive to students' needs, cognizant of their strengths, and aware of the challenges they face. Preparing preservice teachers to teach diverse populations is relevant to all areas of teacher education, including mathematics courses for preservice teachers. Mathematics is a subject intrinsically linked with social justice and as such plays an important role in deepening preservice teachers' understanding of students and their lives. This manuscript shares one example of a social justice-based lesson conducted in a mathematics content course for preservice K-8 teachers. The lesson engaged preservice teachers in mathematical problem solving while challenging their perceptions about homelessness.

Key words: K-8 Preservice Teachers, Real-World Problem Solving, Social Justice, Homelessness

The demographics of public schools in the United States are changing. By some estimates, students of color already comprise the majority of the school population (National Center for Education Statistics (NCES, 2013); similarly, it is believed that students receiving free or reduced lunch represent approximately half of students enrolled in public schools (Southern Education Foundation, 2013); and in 2011-2012, English Language Learners (ELLs) comprised 9.1% of the public school population (NCES, 2014b). These students bring to the classroom a wealth of cultural practices and experiences, yet they are ill-served by the educational system. This is manifested in many ways, but can most easily be quantified with graduation rates and test scores: African-American, Latino/a, Native American, low-income, and ELL students have lower graduation rates and test scores than their Caucasian and Asian, middle-class counterparts (NCES, 2014a; Villegas, 2007).

Part of the problem is that teachers are not adequately prepared to teach diverse students. The teaching force is not sufficiently diverse: teacher education programs are populated primarily by Caucasian females from privileged backgrounds, who have little prior experience with diversity, and are unfamiliar with cultures different from their own (Kitchen, 2005). This

lack of knowledge and experience often results in stereotypes about students; instead of attempting to build curriculum around their lives and experiences, preservice teachers (PSTs) see diversity "as a problem to be overcome" (Villegas, 2007, p.374) and attribute student failure to perceived deficits in their cultures (Ladson-Billings, 2006; Villegas, 2007).

Teacher education programs are tasked with challenging these deficit beliefs and preparing teachers to provide quality instruction to *all* learners. According to the document *Principles to Actions* created by the National Council of Teachers of Mathematics (NCTM, 2009), "an excellent mathematics program requires that all students have access to a high quality mathematics curriculum, effective teaching and learning, high expectations, and the support and resources needed to maximize their learning potential" (p. 59), adding that "effective mathematics instruction leverages students' culture, conditions, and language to support and enhance mathematics learning" (p. 63). This is no easy task, and cannot be accomplished through just one designated multicultural class (Ladson-Billings, 2000). Rather, it has to be a sustained effort by all those involved in teacher education, including mathematics educators.

One strategy to addressing this issue is exposing PSTs to issues of social justice. Because numbers and data are present in discussions about any social justice topic, mathematics is a powerful tool for analyzing those numbers and data. Gutstein (2006) proposed the following as his central argument: "Students need to be prepared through their mathematics education to investigate and critique injustice, and to challenge, in words and actions, oppressive structures and acts – that is, to 'read and write the world' with mathematics" (p. 4). Students and teachers have done this when they used mathematics to argue that their schools were overcrowded, that their neighborhoods were inundated with liquor stores, or that race was a factor in approving home loans in Chicago (these and other examples can be found in Gutstein & Peterson, 2013). Proponents of teaching mathematics for social justice argue that this approach to teaching mathematics not only increases student engagement, but also provides them with a sense of agency (Leonard, Brooks, Barnes-Johnson, & Berry, 2010).

By using mathematics in this manner, PSTs learn about important issues they will deal with as teachers, gain appreciation of usefulness of mathematics in understanding the world, and see potential of using similar contexts in their own teaching. There is a growing body of literature about incorporating social justice concerns into mathematics courses (e.g. Aguirre, 2009; Gay, 2009; Jacobsen, Mistele, & Sriraman, 2012; Rodriguez & Kitchen, 2005). This manuscript continues the conversation about the transformative potential of social justice contexts used in mathematics content courses for preservice K-8 teachers.

Homelessness in the United States

While on the decline in the recent years, homelessness remains a major problem in the United States. A person or family is considered to be homeless if lacking a "fixed, regular, and adequate nighttime residence" (U.S. Department of Housing and Urban Development (HUD), 2013). This may mean living in an emergency shelter, transitional housing (e.g. sleeping on a friend's couch), or moving frequently (at least twice within 60 days) from one residence to another (HUD, 2013). Approximately 600,000 people are homeless on any given night (HUD, 2013). While the face of homelessness in the eyes of many continues to be a middle-aged male who has chosen to live in the streets, the reality is very different. It is estimated that approximately 39% of the homeless population is under the age of 18 (HUD, 2013).

While the total homeless population has been decreasing, the family and youth homeless population has been on the rise. An estimated 1,200,000 homeless students are currently enrolled in the U.S. schools (National Center for Homeless Education, 2014). Because of their unstable living conditions, it is more difficult for these students to succeed in school: they may frequently change schools, not have an appropriate place to do homework, be unable to afford school supplies, and be unable to focus in class, just to name a few. The McKinney Vento Homeless Education Assistance Act is a federal law designed to "address the problems that homeless children and youth have faced in enrolling, attending, and succeeding in school," by providing "equal access to the same free, appropriate public education, as other children and youth" (United States Department of Education, 2004).

Partly due to the increased access to schooling this law provides and partly due to the rise in youth homelessness, homeless students can be found in classrooms everywhere, regardless of the socioeconomic status of a school or neighborhood. Because of their difficult living conditions, homeless students are often difficult to teach. Clearly teachers need training in working with homeless students, but this is not the role of my class, which is foremost a mathematics course. As a mathematics instructor, however, I can introduce the topics of homelessness through a mathematics lesson, with the hope that in the process of problem solving, PSTs can begin to grapple with the complexities of the issue.

Context

The Course

The lesson described here took place in the first of two courses required of all preservice K-8 teachers, both of which I have been teaching at the university for six years. The mathematical foci of the course are number and algebraic sense, and in particular a significant part of the course is spent investigating rational numbers and proportional reasoning. In addition to deepening PSTs' understanding of mathematics, the class also emphasizes

real-world problem solving, especially through contexts relevant to future teachers and global citizens, such as sweatshop labor, education statistics, wealth distribution in the United States, and others. The mathematics in these lessons and assignments is "messy," and requires real-world problem solving strategies: for example no algorithms are suggested, not all information given in the problem may be relevant, and additional information may be needed to solve them.

There are typically 20-24 students enrolled in the course, the majority of whom are Caucasian females in their late teens or early twenties. Though many have encountered ideas related to social justice in other courses, none have ever experienced them in a mathematics class. Most PSTs are open to this approach to learning mathematics and especially appreciate that it makes mathematics more relevant to the real world, something they did not experience in school. However, some are uncomfortable with the social justice component of the course, and others successfully complete assignments but are not impacted by their content. To increase engagement, I have recently been creating lessons about topics that are likely to be more relevant to PSTs. In particular, when topics presented are related to children, PSTs tend to react more positively to the assignments.

The Assignment and Methodology

My university organizes a Hunger and Homelessness Awareness Week every year. During this time, a number of events take place on campus, ranging from panel discussions to interactive poverty simulations. Cards displaying statistics about poverty and homelessness are prominently displayed around campus, and being quantitative, they easily lend themselves to mathematical explorations. As such, they provided an excellent foundation for the assignment described here.

Because there is much content to cover in the course, this assignment was given as homework and discussed in class on the due date. PSTs had the option of completing it individually or in a group. Please note that the data used in the lesson are older than those from the introduction, and thus the percentages may not match.

I collect all student work in the courses I teach, including the work on this assignment. Because of the small class size data analysis consisted of careful readings of all the assignments, with a special emphasis on solution strategies, misconceptions, and themes in reflections about the lesson.

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Student Work
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Problem Solving

The mathematics involved in the assignment was predominantly related to fractions and proportional reasoning. PSTs were tasked with making sense of the sometimes contradictory data obtained from the facts displayed

around campus. Six problems were posed, two of which will be considered here in more depth.

Problem 1. *A study done by the National Law Center on Homelessness and Poverty states that approximately 3.5 million people, 1.35 million of them children, are likely to experience homelessness in a given year (National Law Center on Homelessness and Poverty, 2007).*

   1. *How do you think the study cited above came up with the numbers 3.5 million and 1.35 million?*
   2. *If the figures above are correct, approximately what fraction of homeless population are children? (Use a convenient fraction, such as 1/2, 1/3, etc.)*

The first question was posed to invite PSTs to think about the way mathematics is really used in the world: counting any population is not trivial and requires the use of mathematical models. However, as the uses of mathematics in the world typically remain hidden from view, PSTs had a difficult time with this question. Most understood that estimating was involved because of the impossibility to obtain an accurate count of a population that is typically transient, but a few still thought that a census had been used. Other suggestions included conducting a count in one part of the country and scaling it up to the entire United States. While the mathematics of this idea was more sophisticated than others, it is not feasible, since prevalence of homelessness varies greatly across the U.S. Finally, a few PSTs suggested a head count in shelters, which would result in a significant undercount, since so many homeless people remain unsheltered. These responses highlight the need to bring the hidden mathematics to the forefront. The question of counting populations is an essential one for humankind, and PSTs should be ready to tackle it.

The second question is also relevant to how mathematics is used in the real world: if we were writing a report about child homelessness in the United States for the general public, we would need to use numbers that are easy to understand. Large numbers are difficult to comprehend, and it is often easier to deal with a simple fraction or ratio than raw numbers. The question is also closely related to topics important for PSTs, in particular fraction sense and knowledge of equivalent fractions. Below are some successful strategies that PSTs used.

Strategy 1: Reduced the fraction 1.35 million/3 million to 27/70 and rounded 27 to 30, obtaining 30/70=3/7.

Strategy 2: Calculated 3.5/1.35, which is approximately equal to 2.59, rounded this number up to 3, and concluded that the fraction was 1/3.

Strategy 3: Calculated that 1.35/3 is approximately equal to 43% which makes the fraction close to 2/5.

The actual fraction is closest to 3/7; however, many people are more familiar with fifths than sevenths, so 2/5 may very well be a better choice. The second response brings up the issue of rounding: there are many contexts in which

rounding 2.59 to 3 makes sense, but in this case, rounding creates a large relative error, even if 1/3 is an easy fraction to work with.

      Problem 2. *In addition to the lack of resources to combat the problem the most pressing issue involved with family homelessness is the plight of the children involved. Estimates of the number of homeless children range from 800,000 to 1.2 million, and recent estimates state that 1 in 50 children in the United States are homeless. (National Center on Family Homelessness, 2009). What's more, at least half of homeless children are under the age of 5. (National Center on Family Homelessness, 1999)*

1. *Why do you think this estimate of the number of homeless children is different than the previous one?*
2. *According to the U.S. Census Bureau, here are population estimates for ages birth to 19:*

Table 1
Population estimates for U.S. population ages birth to 19 from 2010.

Under 5 years	*21,299,656*
5 to 9 years	*20,609,634*
10 to 14 years	*19,973,564*
15 to 19 years	*21,537,837[1]*

Is it accurate to say that 1 out of 50 children in the U.S. are homeless? If not, where do you think this figure came from?

      The second problem posed difficulties for PSTs. Some did not even attempt to solve it, or just gave a "yes" or "no" answer to the question without an explanation. Those who did solve the problem added up the numbers of all youth ages 0 to 19 (83,420,600). Though a few noted that this number was incorrect because 18 and 19 year-olds should not be included in the count of children, none tried to give an estimate of the actual number. Because of this, none were able to confirm the 1 in 50 figure. Accustomed to textbook problems in which only necessary information is given, PSTs were not prepared to tackle a problem where data had to be modified to answer the question correctly, especially since nothing in the wording of the problem indicated that additional strategies needed to be made. Nevertheless, they exhibited some interesting mathematical strategies, some of which are listed below.

Strategy 1: Using percentages: 800,000/83,420,691 is approximately equal to 0.959% and 1,200,000/83,420,691 is approximately equal to 1.43%, whereas

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[1] As it is difficult to find pertinent information for assignments like this one, the information given in the table does not exactly match the information in the claim: it may not be from the same year, and it is unlikely that 19 year-olds are considered children in the homeless count.

1/50 is 2%. The PST concluded this was a somewhat accurate estimate, and that the rounding occurred because 1 in 50 sounded better than 1.5 in 100.

Strategy 2. Using rounding and equivalent fractions: 800,000/83,420,691 is approximately equal to 1/100 and 1,200,000/83,420,691 is approximately equal to 15/1000. The PST concluded that 1/100 and 1/50 are not close enough and that the estimate was not accurate.

Strategy 3: Reasoning without numbers: because 18 and 19 year-olds were included in the count, the estimate is inaccurate because "it makes the numbers seem high." This strategy is interesting because the PST realized that the numbers were inaccurate, but concluded that this made the percentage higher instead of smaller.

Neither answer in strategies 1 and 2 is incorrect, as 1.5% may or may not be considered close to 2%, depending on context. Once again, real-world mathematics in this question proved to be messier than mathematics found in textbooks.

The first question asked why the two estimates were so different, which once again required some thought about how homeless counts are conducted. Few considered the fact that different agencies may have reasons for overcounting or undercounting the homeless population. Instead, many focused on irrelevant issues. For example, one wrote, "This may be different because there may be children that can't afford school or just don't attend school." While not attending school is an issue, it is not relevant to how homeless children are counted.

In two other problems, PSTs first compared the ethnic breakdown of the homeless population to that of the entire United States and second determined whether it would be possible to afford an apartment if making a minimum wage. The homeless population in the United States is disproportionately African American, Hispanic, and Native American, but because of the imprecise wording and the fact that PSTs did not understand the term "disproportionate," they were unable to solve the first problem correctly. The issue of disproportionate representation occurs frequently in social justice-based mathematics contexts, and is therefore one to pay closer attention to in the future. The second problem did not pose difficulties, and was in fact one that prompted strong reactions in the responses, as it showed that a one-bedroom apartment was unaffordable for a person making minimum wage.

Reflections

For the conclusion to the assignment, PSTs wrote a paragraph explaining what they learned while working on the activity. The reflections showed that the assignment challenged their perceptions about homelessness. A few noted that they learned it was difficult to make a living with a low-pay job. One reflection especially elaborated on this theme:

> Seeing the stats from the question about the poverty level for a family of 3 really opened my eyes. With the job market these days, it is considered awesome to have a job that pays the minimum wage. And say a single mother raising 2 children …works …40 hours a week for 52 weeks a year – even then she is living below the poverty level.

Mathematics also figured prominently in the reflections. For example, a few reflections noted that presentation of data affects perceptions. One wrote,

> I also found this project interesting because the way you state the data (in percent, fractions, numbers) effects [sic] how someone will perceive them. It's a way of manipulating numbers in favor of a cause without actually manipulating them, for example, is it more effective to say "1 out of every 50 children is homeless," "2% of children in the U.S. are homeless," or "1.2 million children in the U.S. are homeless"?

One group thought more about the meaning of the "1 in 50" figure and concluded that this meant that "[f]or every 50 children one of them will be homeless," and that this would "add up quickly." These observations give partial answers to questions essential for understanding proportional reasoning: When is it appropriate to use multiplicative comparisons (i.e. the use of ratios and percentages) and when to use raw numbers? What information does each give us? And what do the ratios really mean?

On occasion, the assignments showed PSTs' lack of understanding and sensitivity about these issues, like the following response to the question about the racial and ethnic breakdown of the homeless population: "The first thing was that the distribution of race in America wasn't as bad as we thought. Originally we thought that races like Hispanics and Asians would be closer to the Caucasian race." While problematic, this comment was an exception. Much more frequent were comments that expressed genuine surprise at the information learned, and willingness to reconsider their previously held stereotypes.

For some PSTs, the assignment resonated with personal experience, and these reflections were the most powerful ones. One PST in particular was willing to share her mother's story:

> I myself have had experience with the inaffordability [sic]. My mother, at the moment, is stuck without a home of her own because what she makes right now, $10 an hour, is not enough to rent a home and pay for the rest of her expenses…. This project really illustrated to me that this is a problem for the entire nation, not just my mom and needs to be understood and acted upon.

In this PST's case, mathematics truly was a powerful tool for reading the world, as she was able to use the mathematical information to put her mother's plight in context of a larger issue.

As expected, the PSTs paid special attention to the parts of the assignment pertaining to children, as exemplified by this quote: "Hunger and homelessness are serious and need to be paid attention to no matter the

number, especially when children are involved." Because of its focus on youth, this assignment challenged PSTs' stereotypes about homelessness in a more meaningful way. It also allowed them to look at homelessness as a societal problem, rather than a result of shortcomings of those who are homeless.

Discussion

The lesson showed potential for PSTs to engage in real-world mathematics and also pinpointed weak areas that should be addressed in the future. For example:

1) PSTs need more experience with real-world mathematics. In particular, they should learn to question the usefulness and correctness of data given in a problem, as they would (one hopes) in a real-world situation.
2) PSTs need more experience with real-world mathematics that is typically hidden from plain view, as is the case with estimating sizes of populations.

The lesson highlighted some mathematical misconceptions, which included incorrect rounding and incorrect use of percentages. However, it also exhibited flexibility in mathematical thinking and PSTs' ability to use their own strategies rather than algorithms, especially when using an algorithm was not the easiest strategy. Many were able to use the information given in a meaningful way and draw pertinent conclusions.

Equally important was the PSTs' ability to reflect on the issue of homelessness. Their perceptions about who is homeless and why seemed to change as a result of the lesson. The reflections showed the transformative potential of this and other social justice-based lessons, as a number of PSTs understood that homelessness is a societal issue, and not a shortcoming of those who are homeless. If sustained, this understanding can help PSTs become effective teachers of all children, not just those with stable homes and parental incomes.

Limitations and Future Work

My work with PSTs is limited to at most two semesters. As these are primarily content courses whose purpose is to provide PSTs with deeper mathematical knowledge needed to teach elementary (and possibly middle) school, the time allotted to social justice contexts is modest. Furthermore, I do not follow the PSTs once they leave my class into student teaching and their own classrooms, and have been unable to measure the long-term impact of the social justice-oriented lessons like the one described above. The information I obtain about the short-term impact of the lessons is also not completely reliable, as it comes from graded reflections. With this caveat, it is still worth noting that reflections, comments from course evaluations, and informal

conversations I have with PSTs all show that the ideas of teaching mathematics for social justice are intriguing to many of them.

I have conducted anonymous evaluations for different assignments, and have recently begun implementing a survey created with colleagues to gauge PSTs beliefs about teaching real-world topics and controversial topics such as homelessness (Simic-Muller, Fernandes, & Felton, 2015). In order to better understand the effect of incorporating social justice topics into mathematics contents courses for preservice teachers, it is important to carefully document the work done and create instruments that will be able to measure it.

Conclusion

The intent of this manuscript is to provide a glimpse into the type of work that is possible in mathematics content courses for PSTs. The assignment described here required mathematizing real world-contexts, and through manipulation of real-world data strengthened PSTs' mathematical skills. Mathematics was essential in understanding poverty and homelessness, which showed its power and usefulness beyond the typical examples with time and money PSTs often give when asked about uses of mathematics (Lee, 2012). The issue presented was highly relevant to future teachers, hence PSTs were more likely to pay attention to it and the mathematics used to explore it. I found it helpful to connect the assignment with events taking place in our community, as it showed the issue as the concern of the entire university rather than just my own; but this is not necessary. This assignment barely begins to address all possible types of mathematical problems one could pose about homelessness, but still provided a successful starting point for a conversation about this uncomfortable topic. Exploring this and similar issues helps PSTs gain a deeper understanding of obstacles some communities face, making them more committed to providing high quality education to all their students.

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