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Preservice Teachers' Changing Conceptions About Teaching Mathematics in Urban Elementary Classrooms

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In this article, the author reports on a project intended to gain insight into the effect a specific constructivist learning opportunity might have on preservice teachers' beliefs and attitudes about the value of conceptual-based instructional methods for urban children. The project context was an elementary mathematics methods course; the weekly learning opportunity asked students to write about an authentic mathematical experience that they had had during the week. Students were required not only to summarize the experience but also to explain how they solved the problem in ways that did not involve a school-taught algorithm or a calculator. The author argues that completing this assignment resulted in more than building preservice teachers' mathematical knowledge and skills; it also provided them with an opportunity to learn within a constructivist framework, and to see that learning is about the relevance of curriculum and the meaning individuals make of it rather than the demographics of learners.

KEYWORDS: elementary teacher education, constructivist teaching, mathematics teacher education, teacher beliefs, urban education

Promoting mathematics learning environments that privilege students' conceptual development over the "traditional" rule-based, procedural methods of instruction has been a primary focus for the National Council of Teachers of Mathematics (NCTM) for over two decades (NCTM, 1989, 2000). The enriched learning opportunities for students who experience a conceptual-based learning environment are well documented in the mathematics education literature (Fitzgerald & Bouck, 1993; Hiebert, 2003; Spillane & Zeuli, 1999; Sutton & Krueger, 2002). Students in such environments often excel with respect to greater flexibility, sophistication, confidence, and competence with both routine and non-routine problems and computations (Donovan & Bransford, 2005; National Research Council [NRC], 2001). The pedagogical methods that foster such conceptual learning, however, are not routinely reaching and/or being implemented in urban classrooms (Berry, 2003; McKinney, Chappell, Berry, & Hickman, 2009). Too often in urban classrooms an "initiation-response-evaluation" (IRE) pattern (Hie-

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bert & Stigler, 2000) remains the dominant instructional practice (Lubienski, 2002; Strutchens & Silver, 2000). Here, students listen to what their teachers say and do, try to remember it, and then attempt to parrot it back on homework assignments and tests (Heuser, 2000). Within this method of instruction, there is little emphasis on developing conceptual understandings by having students explain their thinking, make conjectures, or discuss ideas and strategies (Franke, Kazemi, & Battey, 2007). Thus, many teachers in urban classrooms, as well as others who employ such instructional methods, should rethink their pedagogical practices to keep their students competitive when it comes to mathematics (Ladson-Billings, 1997; NRC, 2001).

Putting the onus on teachers is not meant to be punitive. Rather, it is meant to *self*-empower teachers by acknowledging that within the context of schools, teacher quality is the most direct measure of students' academic achievement and success (Brown, 2002; Haberman, 2005; Ladson-Billings, 1994; Steinberg & Kincheloe, 2004). In other words, effective teaching matters! Bringing about change in urban teachers' pedagogical methods and practices, however, must begin by addressing their beliefs about what constitutes effective mathematics instruction for their students (Klein, 1998; Steele & Widman, 1997). Here, beliefs are defined as convictions that resist change and are not necessarily contingent upon either reason or evidence (Watters & Ginns, 1997). Such beliefs have been found to be far more influential than knowledge in determining how individuals organize and define tasks and problems and are stronger predictors of behavior (Pajares, 1992). Moreover, it has been argued that beliefs about "good" teaching are well established by the time students get to college (Grossman, 1990; Pajares, 1992).

Therefore, it is important for teacher educators to ensure that preservice teachers' incoming beliefs about teaching are explored, discussed, and revised (if necessary). This recommendation is especially relevant for prospective teachers' initial beliefs about teaching in urban classrooms because research has shown that preservice teachers believe that urban students require mathematics instruction that focuses on basic skills (Gilbert, 1997; Walker, 2007), rote teaching and learning (Anyon, 1997; Breitborde, 2002), and repetition (Walker, 2007). Addressing this cultural bias among preservice teachers is critical in light of the previously mentioned literature on the persistence of ineffective pedagogical methods and practices in urban mathematics classrooms and the resilient nature of established beliefs. Moreover, interventions aimed at preservice teachers' beliefs about teaching mathematics in urban schools must result in authentic conceptual change by first confronting their original perspectives (Harrington & Enochs, 2009; Klein, 1998; Steele & Widman, 1997). Without such an authentic struggle, many preservice teachers may revert to teaching in the traditional ways they experienced in their own schooling rather than implementing the sort of conceptual-based instructional approaches they are taught and exposed to in their teacher education programs (Ebby, 2000; Merseth, 1993).

Accordingly, the purpose of the project reported here was to gain insight and perspective into the effect constructivist learning opportunities might have on preservice teachers' beliefs and attitudes about the value of conceptual-based instructional methods for urban elementary mathematics students. The context for the project was an undergraduate elementary mathematics methods course at an urban university where the College of Education has an explicit mission of preparing teachers for urban, multicultural settings. Specifically, preservice teachers were given a weekly assignment for which they had to write about an authentic mathematical experience they had during the week between classes. They had to write a summary of the situation as well as explain how they solved the problem in ways that did not involve a school-taught algorithm or a calculator. Completing this assignment resulted in more than building preservice teachers' mathematical knowledge and skills; it also provided them with an opportunity to learn within a framework consistent with the NCTM, and to see that learning is about the relevance of curriculum and the meaning individuals make of it rather than the demographics (e.g., race, gender, class, etc.) of learners.

In this article, I first outline the theoretical perspective for the methods course I teach, followed by a description of how I address constructivism as a pedagogical framework. I then share the structure of my methods course before introducing the participating preservice teachers, data sources, and methods for analysis. I then present the results of my findings and provide examples of preservice teachers' work. Finally, I elaborate on the results in the context of preservice teachers' changing perceptions about the value of conceptual-based pedagogical methods and practices in urban mathematics classrooms.

My Mathematics Methods Course

Theoretical Perspective of the Methods Course

The previously noted literature supports a vital and practical purpose for this project. Nonetheless, the original motivation for it came from the in-class experiences I was repeatedly having with preservice teachers surrounding their attitudes and beliefs about the value of constructivism for teaching mathematics in urban classrooms. I decided to examine these experiences systematically and to study the effects that the design of my methods course might have on preservice teachers' attitudes and perceptions about teaching mathematics in urban settings.

Constructivism (defined later) is the central theoretical and organizing perspective for my methods course; I introduce it introduced at the beginning of the quarter as a general theory for how people learn, and one that informs myriad instructional practices in mathematics teaching and learning and other disciplines. However, despite a general affinity for constructivism as a framework for practice, preservice teachers often challenge the value of it for urban children's mathematics learning experiences. Specifically, preservice teachers too often contend that urban children need to be "kept on task," motivated, and taught in ways that constructivist-influenced classrooms cannot and do not support (Jepsen, 2009).

Contrary to this popular belief, research shows that urban children and youth do indeed thrive in constructivist learning environments because of the theoretical and practical foundations such environments provide (Griffin, Case, & Siegler, 1994; McNair, 2000). Therefore, one of the most important components of my methods course is not only to expose preservice teachers to literature that supports constructivist learning environments but also to ensure that the preservice teachers themselves have mathematical learning experiences that substantiate the general value of constructivism in teaching and learning. This means that it is not enough for me to talk to preservice teachers about the value of constructivism for pedagogical decision-making; that would merely be modeling and sanctioning an IRE strategy of instruction. Rather, I must ensure opportunities for authentic constructivist learning opportunities as part of preservice teachers' overall course learning experiences.

Discussing Constructivism as a Framework for Pedagogical Practice

Early in the quarter, I introduce the origins of constructivism as a theoretical construct most often attributed to Piaget's theory of child development (Piaget, 1952). We discuss the evolution of constructivism in the context of criticisms of Piaget's theory, including challenges to the universality of his stages and the undefined role for a teacher in children's learning (e.g., Laurenco & Machado, 1996). We then look at the ways these challenges to Piaget's theory have led to diverse interpretations and adaptations of constructivism for mathematics education, most specifically by those situated in sociocultural frameworks for learning (e.g., Cobb, 2006; Cognition and Technology Group at Vanderbilt, 1997; Lampert, 2003; Vygotsky, 1962).

A particularly robust theoretical contribution of Piaget's that we revisit throughout the course relates to a basic definition of constructivism. In this definition, constructivism is described as the process of cognitive structures changing, and thus individuals learning, as they are exposed to external, authentic environments and integrate information by either assimilating or accommodating it (Bollinger, 2006). Admittedly, this is an extremely oversimplified and abbreviated definition. However, two important aspects of it are presently relevant. First, the reference to *individuals* implies that the theory does not discriminate based on age, race, gender, domicile, or any other demographic data. Rather, research shows consistent developmental progressions within children across cultures (Okamoto, Brenner, & Curtis, 2002), social class (Griffin, Case & Siegler, 1994), and so on. These progressions are not necessarily seen uniformly with respect to the timing and rate of achievement, but the progressions do appear to occur in a predictable and structured fashion.

Second, interactions with external, authentic environments are critical to a learner's development (Bollinger, 2006; Webb, 1980). In typical school settings, students of all ages and demographics engage with mathematics in ways that mimic, model, or even demonstrate the mathematical demands of the "real world" (Ninnes, 2000; Sundberg & Goodman, 2005). However, situations that *reflect* the "real worlds" of students are not the same as authentic situations that are in real-time, and are unique to and current in their lives (Gravemeijer, 1997). These latter, real-time situations are found in children's mathematical activities such as shopping, playing sports, and cooking, and require spontaneous and functional applications of mathematical knowledge and skills.

Having a personal connection with curriculum in order for effective learning to take place is neither a new proposition, nor attributable to Piaget. Indeed, Dewey wrote about it over a century ago (Dewey, 1902). Dewey's ideas along with those that fall within the framework of situated learning and cognition are also discussed extensively in my methods course. These perspectives are elaborated on in class as we extend the general argument to include the need for mathematics curriculum to be personally meaningful in order to motivate children—in particular, urban children "whose life experiences often are farthest from the traditional school curriculum experience" (McNair, 2000, p. 552).

Structure of the Methods Course

The relevant methods course met once per week for 10 weeks. Each class session was 3 hours, and had time allocated for a variety of learning opportunities, including the discussion of field experiences, assigned readings, and doing mathematics-related activities including the *Math in the Everyday Life* assignment (discussed later). Also, independent of class time, individual students (i.e., preservice teachers) attended an assigned field placement once per week for 10 weeks. Each visit lasted for approximately 90 minutes. During these visits, students were required to go beyond observing, and had to plan for and teach mathematics lessons in collaboration with and independent of their cooperating teachers.

The Research Project

Participants

Twenty-three undergraduate elementary education students participated in the project (20 women; 3 men). Eighteen of them were seniors and five were juniors. Two of the men identified as Latino, and one as African American. Eight of the women identified as Latina, four as African American, and eight as Caucasian. The mean age was 21, and 15 of the students indentified as urban by birth and 3 by current domicile.

As mentioned, our College of Education has an explicit mission for preparing teachers to teach in urban, multicultural settings, with an emphasis on serving the poor and disenfranchised. Thus, all students must engage with field experiences in schools that reflect this demographic. However, most students also spend time in contrasting environments including suburban schools, independent secular schools, public schools in middle-class neighborhoods, and parochial schools. The methods course described here was among the last of the courses preservice teachers take before student teaching. Thus, most had been in at least one school with a population of low-income families, an independent parochial school, and a public school in a middle-class municipal or suburban neighborhood. For this particular course, students were individually placed in schools with a population where they either needed to accumulate experience and time, or were most interested in ultimately teaching. Accordingly, 13 of the preservice teachers were placed in urban, "high-needs" schools with respect to serving low-income, historically marginalized and underserved students.

Data Sources and Analyses

As Ebby (2000) points out, "a constructivist perspective focuses on the process of coming to know rather than on only the outcomes" (p. 75). Accordingly, I used ethnographic methods of data collection and analysis in order to gain a deeper understanding of participants' perceptions, attitudes, and beliefs that drive their decisions (Cohen, Manion, & Morrison, 2000). The study involved three main data sources collected throughout the quarter. Two sources used for analysis were instructor-initiated whole class discussions, and a review of preservice teachers' written work. The *Math in Everyday Life* (MIEL) assignment described next was used to contextualize and analyze students' learning and comments. Details of the analytic methods are elaborated within descriptions of each data source.

The MIEL assignment. The purpose of the MIEL assignment was to provide each student with the opportunity to identify and then to do mathematics in authentic and personally relevant ways that reflect the values and premises embedded in constructivism. Each week, students submitted an MIEL, which was an account of having done some mathematics that was real and necessary in their non-teaching lives (Kalchman, 2009). Typical contexts included tipping, exercising, dieting, shopping, cooking, and paying bills. Preservice teachers were required to communicate the relevant situations and to show how they did the requisite mathematics, and encouraged not to use calculators and formal, school-taught algorithms. Instead, they were encouraged to apply strategies that were context-driven and situation-dependent and responsive to the circumstances at hand. For example, it is not typically convenient to pull out a calculator or pencil and paper when sitting in the back of a taxi trying to calculate a tip. Thus, students had to describe and explain their thinking, and communicate the steps they took to solve their problems. Finally, they were encouraged to ask other people how they would solve the same problems.

Then, each week students either voluntarily or at my request shared their MIEL with the class. I typically asked those whose problems presented unique challenges and required some alternative thinking. Furthermore, if possible, I tried to choose submissions that would have some relevance to an urban child's lived experiences, not only to support our College's mission but also to address the educational needs of urban children. Groups of preservice teachers then engaged with the mathematics of the selected MIEL and shared their solutions and strategies. Then, as a class, we discussed the constructivist processes and implications of each group's problem solving strategies. For example, we explored particular features of the process such as how difficult it was to think like and interpret problems like someone else and how surprising it was that there were so many ways to solve a seemingly simple and routine problem.

Instructor-initiated whole class discussions. Twice in the quarter, I initiated a whole class discussion specifically about the relevance of constructivism for discrete populations such as urban students. Significant to the resulting conversations was the fact that in my methods course we do not delve into the unique complexities of teaching and learning in urban classrooms as a course topic per se. These issues are confronted in other courses specific to the foundations of education, and I expect students to come to my classes with some experience with and knowledge of the pertinent issues. Rather, in our discussions, we focused on the implications of different learning cultures and environments, rather than on the environmental and cultural circumstances that necessitate the conversation.

The first discussion was initiated in the second week of the course following a lecture-style overview of constructivism as per the theoretical perspective previously described. I opened this conversation by asking students if they believed that putting constructivist theory into practice with all children in all mathematics classes is both plausible and desirable, and to elaborate on and justify their beliefs. The ensuing conversation was completely organic to their ideas. The second discussion was in week 10 of the quarter after we discussed literature related to changes preservice teachers make in their beliefs about teaching and learning mathematics as a result of their experiences in a methods course with highly integrated field experiences (Ebby, 2000). I opened this conversation by asking them to consider and share any changes they experienced over the course of the quarter as they relate to teaching and learning mathematics for themselves and for children. I asked them to refer specifically to and comment on different student populations and on different instructional styles they had observed in their field experience for the mathematics methods course and in their teacher preparation program in general.

These conversations were audiotaped. Transcriptions were coded to reflect categories of initial beliefs about the pedagogical needs of urban children: initial beliefs of not believing in constructivism (IN), initial beliefs of being undecided about the value of constructivism (IU), and initial beliefs of believing in constructivism (IY). Codes for the second conversation involved two levels of categorization. First, transcripts were coded to reflect students' beliefs at the end of the course: outgoing beliefs not favoring constructivism (ON), undecided outgoing beliefs (OU), and outgoing views of believing in the value of constructivism (OY). Transcripts then were coded to reflect conceptual shifts attributed to a particular aspect of the course: ΔMIEL, ΔFE (field experiences), ΔCD (class discussions), and combinations of the three.

To analyze the data, I first looked quantitatively at the number of relevant comments the preservice teachers made in each of the categories during both structured discussions. Then, I attributed each comment to individuals in order to account for each student's pre- and post-quarter positions. I then coded the reasons they gave for maintaining or changing their perspectives and recorded those to reflect each contribution.

Review of preservice teachers' written work. Students were not required to write about their perspectives on urban mathematics education per se. But because of the explicit mission of the College, many of them were completing their field experiences in urban classrooms; therefore, the topic of urban classrooms appeared with some frequency in their written work, especially toward the end of the quarter.

In addition to the MIEL, preservice teachers had two other written assignments. The first was their "Weekly Contribution." For the first 10 to 15 minutes of each class session, students wrote short pieces about a topic, or topics, they hoped to discuss in the forthcoming class session. The topics they wrote about were at their discretion and ranged from those related to the readings and/or their field experiences to relevant current events. These pieces were coded using the same codes previously described if content warranted it. However, each code was preceded with a "WC" to indicate that the comment was made in the context of the Weekly Contribution. To illustrate, if a student mentioned an experience in a classroom that affected or contributed to a change in his or her perspective on pedagogy for urban children, the code would read "WC-ΔFE."

The second written assignment was a final essay describing and reflecting on a mathematics lesson the preservice teachers taught in their field-placement experience. Of particular relevance to this project were sections on "Pedagogical Choices" and "What You Learned About Teaching and Learning Elementary Mathematics." In the case of the former, they were required to explain and justify the sort of pedagogical approach they intended to use in the pre-planning of their upcoming lessons (Artzt & Armour-Thomas, 2002). This assignment was due in the final week of the quarter; thus, the pedagogical choices they made were significant. If the pedagogical choice reflected a constructivist perspective, then the entry was coded as PCC; it was coded as PCT for a choice of traditional pedagogy. A “U” was added to each code if the lesson was specific to an urban population. The reflection section of the final papers were also coded for relevance to preservice teachers’ beliefs and perceptions about the pedagogical needs of urban children. These codes were consistent with those reflecting change previously described but were prefaced with “FP” for final paper. I coded and counted the number of relevant written remarks made in preservice teachers’ Weekly Contributions and again in their final assignments.

After establishing a quantitative basis for believing that the MIEL assignments were influential in the changes preservice teachers made in their perspectives on teaching mathematics in urban settings, I began reviewing their comments and written remarks qualitatively. For example, I looked for comparative statements, oral or written, that included before and after remarks and the context and timing for any conceptual epiphanies. I looked for comments they made regarding their observations of instruction in urban mathematics classrooms and how those observations conflicted with or supported our class discussions and their own constructivist experiences.

Findings

Sample MIEL Assignments

The following MIEL samples provide context, and are representative of the sort of MIEL assignments I selected to use as in-class activities. The mathematics activities were challenging enough for elementary-level children, involved a variety of conceptual strands (NCTM, 2000), and may have resonated more with preservice teachers as urban experiences than submissions that focused on more generic tasks such as tipping, cooking, or banking.

Figures 1, 2, and 3 are examples of MIELs. In Figure 1, a student shared her process for finding a primary care physician within a certain radius of her home. She used Chicago’s block system to calculate distances. Indeed, the process is a bit dizzying for someone unfamiliar with the city. However, calculating distances and giving and receiving directions using the block system is standard for Chicagoans and an essential code for all who live there. The mathematics involved was diverse and ranged from standard computation to two-dimensional algebraic thinking as the student considered traveling both south and west on the grid.

Math Everywhere

This week my husband and I searched online for a primary care physician for myself. In the selection process, the website instructed us to indicate how far we would be willing to travel to visit the doctor's office. The question was written in miles (5,10,15,20,25), so I had to convert to city blocks (since we don't "talk" miles in the city).

First, I had to remember that 1mile equals 8 city blocks. Therefore, I had to multiply 8 by 5 which is 50. Next, since I live on the 60th block south, I had to add forty to sixty. I knew that 4+6 = 10, add 0+0 = 0, which is 100. So since I was willing to travel to the 100th block in Chicago, I continued on to 10 miles.

First, I multiplied 8 by 10. Since I know that any number times ten is that number with a zero, then I knew it equaled 80. Next, I added 80 to sixty. First, I added forty to sixty to get one hundred, and then I added the remaining forty to get one hundred forty. Well, the 140th block is a bit far, so I wondered if I would go to the 100th block and 40 blocks west (that is not even past Cicero since I know that Cicero is 52 blocks west), so I would be willing to go to Cicero & 100th. So I continued on to 15 miles.

Since I already figured out that ten miles equals 80 blocks, I calculated five more miles and I know that 8 times 5 equals 40. So 80+40, I know that 8+4= 12 and 0+0=0, so 12 and 0 is 120. Would I be willing to travel 120 blocks? Let's see. I live on the 60th block, so I added 60 to 120. I know that 12+6 is 18 and attaching the zero brings us to the 180th block. I would be willing to travel to 115th block south. The remaining blocks I would want to travel west. Ten more to 115 would be 125, so 20 more would be 135, 30 more would be 145, 40 more would be 155. Fifty more would be 165, sixty more would be 175, and so five more would bring us to 180. Sixty and five, or 65 tells me how many blocks I would travel west. As I mentioned before, Cicero is 52 blocks west, and 65 blocks is only a few more west. 115th & beyond Cicero seems far enough from my house. I would not want tot travel any farther, so I selected 15 miles.

After I finally selected a primary care physician, I noticed that their office was on the 94th block and 20th block (Western). I wondered how many miles? First, I subtracted sixty from 94, 9–6 is 3, 4–0=4 so 34. I added 34 and 20. I know timetables up to 12, I know that 8 times 7 is 56, which is too much. So 8 times 6 is 48. It takes two more to get to 50, and 54 is 4 more that fifty. So, 4 and 2 is 6. The office is 7 miles and 6 blocks away from my house. Hmmm, it doesn't seem that far!

Figure 1. Finding a primary care physician using Chicago's city block system.

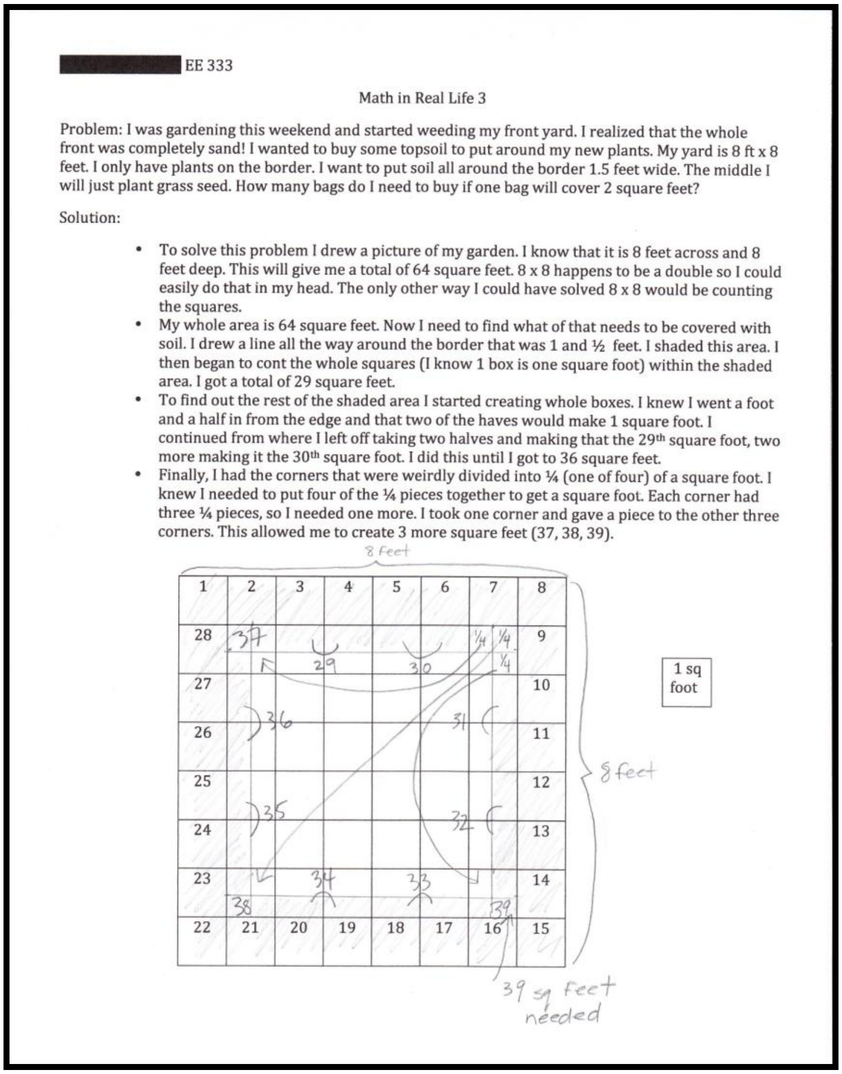
In Figure 2, a student discussed the cost of zoned parking meters in downtown Chicago. The zoned meter system is not made explicit on the machines themselves, but it is essential that visitors and natives alike negotiate it to avoid parking tickets. The mathematics involved included addition, subtraction, multiplication, and division with whole numbers as well as multiplication with decimals. Working with money, specifically, is also part of the measurement strand of the NCTM *Principles and Standards for School Mathematics* (NCTM, 2000).

Math Everywhere

This week math was involved a lot in my life. Most of the time I didn't realize I was using math at the moment but quickly recognized that math was being used in my daily routines. A friend and I were walking down Kedzie Street and there were meters that read "Zone 6" and I asked her what "Zone 6" meant and we both didn't know the answer. However, we figured that it had something to do with number of hours or minutes one quarter gives. We thought that the zoning had to do with time and money because there are certain places in the city that give you more or less amount of time for one quarter. So we quickly changed the subject up to how much money we thought could be spent on one meter daily. We knew that on Kedzie, one quarter gave you an hour and there are obviously twenty-four hours in a day. So to figure out how much money could be deposited into the meter on any given day, we multiplied twenty four times 25 cents. I couldn't think of the product of twenty four times 25, but twenty times 25 gave me 500. I then multiplied 4 times 25 which gave me a hundred and I added the two which gave me 600. Finally, I moved the decimal over two places because the twenty-five was in cents not dollars. So after moving the decimal over two places to the left, we got $6. That particular "Zone 6" meter on any given day could have up to $6 in quarters deposited into it. We then talked about how for different meter zonings more money could be deposited since less time is given for one quarter. The methods I took to solve this problem were convenient because a lot of mental math was done. However, we made an error because there are certain times in the day when money does not need to be deposited. So we would have to subtract those amounts from the original total of $6.

Figure 2. Feeding parking meters in a downtown center.

Finally, in Figure 3, a student wanted to determine how much topsoil to buy to cover a 1.5' border surrounding her 8' x 8' yard. This problem involved using algebraic and geometric thinking along with computing with whole numbers, fractions, and decimals. This problem is relevant to an urban lifestyle because of the ways city-dwellers must often harvest their space if they have a yard and would like to enjoy any part of it as a garden.



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Math in Real Life 3

Problem: I was gardening this weekend and started weeding my front yard. I realized that the whole front was completely sand! I wanted to buy some topsoil to put around my new plants. My yard is 8 ft x 8 feet. I only have plants on the border. I want to put soil all around the border 1.5 feet wide. The middle I will just plant grass seed. How many bags do I need to buy if one bag will cover 2 square feet?

Solution:

- To solve this problem I drew a picture of my garden. I know that it is 8 feet across and 8 feet deep. This will give me a total of 64 square feet. 8 x 8 happens to be a double so I could easily do that in my head. The only other way I could have solved 8 x 8 would be counting the squares.
- My whole area is 64 square feet. Now I need to find what of that needs to be covered with soil. I drew a line all the way around the border that was 1 and ½ feet. I shaded this area. I then began to cont the whole squares (I know 1 box is one square foot) within the shaded area. I got a total of 29 square feet.
- To find out the rest of the shaded area I started creating whole boxes. I knew I went a foot and a half in from the edge and that two of the haves would make 1 square foot. I continued from where I left off taking two halves and making that the 29th square foot, two more making it the 30th square foot. I did this until I got to 36 square feet.
- Finally, I had the corners that were weirdly divided into ¼ (one of four) of a square foot. I knew I needed to put four of the ¼ pieces together to get a square foot. Each corner had three ¼ pieces, so I needed one more. I took one corner and gave a piece to the other three corners. This allowed me to create 3 more square feet (37, 38, 39).

Figure 3. Buying topsoil for a city garden.

Structured Discussions

Discussion 1. The first structured discussion (week 2) lasted for 30 minutes and all 23 students contributed to the conversation. A total of 36 comments were coded and distributed to reflect the findings in Table 1: 61% of the preservice teachers expressed initial beliefs that constructivism was not an appropriate instructional approach for urban elementary mathematics students, 26% were undecided, and 13% believed it was appropriate. Reasons they gave to support their negative reactions fell primarily into three categories. The first was urban students' apathy toward learning: "Those students don't want to learn, and so trying to engage them in discussions about their own thinking in order to reflect on it is not realistic. The conversations would never get started." The second and most popular reason for why urban students are not suitable candidates for constructivist learning environments was illustrated by the following comment made by a mature, Latina:

> Urban kids need more structure and discipline than that. There's no way a group of kids at my school would stay on task if the teacher put them in groups and told them to solve a problem without step-by-step instructions for how to do it. They'd start throwing things or pulling out their cell phones.

The final reason was that "students don't have the background knowledge they need to build new knowledge."

Those who were undecided about the value of constructivism for urban children fell into two categories. Some admitted that they did not really understand the scope and application of constructivism prior to my lecture and were reconsidering their understanding of it before deciding on their position. While others admitted that they had never thought about constructivism in the context of mathematics education before because all of their experience with the term had been with literacy or science education. Furthermore, their incoming model for teaching mathematics was one that focused on a textbook that essentially stipulated what and how they would teach.

Finally, preservice teachers who believed from the beginning that constructivism was the best approach to teaching mathematics in urban schools supported it as a framework for instruction in general, and it was already a part of their evolving philosophy on teaching.

Table 1

Number of Preservice Teachers' With Each Incoming and Outgoing Perspective per Structured Discussion

Discussion	**Initial Perspectives**		
	Initial No	**Initial Undecided**	**Initial Yes**
Discussion 1	14 (61%)	6 (26%)	3 (13%)
	Outgoing Perspectives		
	Outgoing No	**Outgoing Undecided**	**Outgoing Yes**
Discussion 2	0	7 (30%)	16 (70%)

Discussion 2. The second discussion (week 10) also lasted 30 minutes and all 23 students contributed. A total of 32 remarks were coded and attributed to individual students. As recorded in Table 2, at the end of the quarter, zero students disagreed with the idea of constructivism as a guide for instructional practice for urban children. Thirty percent were undecided and 70% agreed with it. Ultimately, 74% of students changed their perspectives. The three students who began the quarter supporting constructivism for urban children remained committed to it. Of the original six who were undecided, three remained so. Four students moved from not originally believing in the value of constructivism for urban children to being undecided, three went from being undecided to agreeing with the notion, and 10 students went from not agreeing with it to agreeing with it.

Table 2

Number of Preservice Teachers per Reasons for Changing Perspectives

	Reason for Change			
Discussion	**MIEL Alone**	**MIEL + FE***	**MIEL + CD****	**MIEL + CD + FE**
Discussion 2	3	5	2	7

Note: FE indicates "Field Experience"; CD indicates "Class Discussion."

All preservice teachers who reported a change in attitude included the MIEL assignment as a factor in their final perspective. Table 2 itemizes the number of preservice teachers who reported a change in perspective per reason or reasons for change. Three cited only their experiences with the MIEL as homework and as an in-class activity as the main reason for changing their perspective. For instance, a White woman who came into the class believing she knew everything she needed to know mathematically for teaching and only needed instructional strategies said:

> Every week when we did the [MIEL] in class I would look around and always be sure that my way of solving the problem was the right way and that my classmates would see why. Then, every week that just wasn't true. Other people would share their work and have answers that made sense and that other people even understood better than how I did it. I learned so much from that about teaching. I can't always believe that my way is the right way or the only way. I have to be able to listen to others and be open to how they solve problems otherwise my students won't relate to me and won't learn from me. I never thought before about needing to figure out how other people do math, especially kids. I figured if it wasn't familiar it wasn't right.

Two preservice teachers attributed their changes to a combination of the class discussions and the MIEL. Representing this change is the following from a

White female student who went from not seeing the value of constructivism for all learners to appreciating it:

> In the beginning I really tried to think about the types of students that [constructivism] would and would not be suitable for. The more we talked about it though and the more we did each other's and our own Everyday Math assignments, I started to think that as long as something is approached in an appropriate manner, it can be suitable for any class, anywhere, any age.

Five attributed their change to a combination of the MIEL and their field experiences. A representative remark from these students was the following, spoken by a White man:

> I am doing my clinical in a 2nd grade classroom at [an urban school]. In the beginning I couldn't imagine how I would use any of the constructivist stuff we were learning about. Students seemed so out of control. Then, my cooperating teacher gave me a small group of students struggling with multiplication. I decided to try some of what we talk about in class. I asked them if they ever had to multiply in real life. They said just for homework. Then I told them how I had to multiply that morning to know how many counters I needed to bring for them. After that, the students wanted to find times in their lives that they used multiplication.

Seven preservice teachers attributed their change in perspective to a combination of the MIEL, their field Experiences, and class discussions. For example, the following quote came from a Latina student who began the quarter not supporting the idea of constructivism for urban children because she believed they needed much more structure and discipline than she perceived a constructivist-influenced classroom could provide:

> When you first asked us what we thought about constructivism for urban students I thought no way. Even listening to my classmates who thought it was a good idea didn't convince me. I've done a lot of my hours in urban classrooms and all of my teachers just give worksheets and tell kids to answer the problems how they were just shown. Then, I got really interested in [my classmate's] garden problem. I love gardening but found it harder than I expected to explain my solution even though I have to solve these sorts of problems a lot. I also know the kids just did area and perimeter in math. For my lesson I brought in soil and seeds and asked students if they could figure out how big of a box we need to make an indoor garden on the science table. I had them sketch different possibilities asking them to maximize and minimize the perimeter and the area. They were so into it and didn't finish the lesson. They asked if they could finish the next day. I'm not sure if they thought they were doing math because they weren't doing a worksheet, but they were doing math in a big way.

Results from Written Work

Weekly contributions. In the first half of the quarter, seven students brought up the issue of constructivism for urban settings in their Weekly Contributions—all in the form of a question and coded as undecided. For example, one student who was placed in an inner city school wrote the following: “Should I be trying to use constructivism with the students in my placement? They just stare at me if I ask them what they think rather than giving them an answer or referring them to an example in their textbook like their teacher does. I don’t think they’re ready for it.”

In the second half of the quarter, however, 17 preservice teachers brought up the topic in their Weekly Contributions, and 10 of those referred specifically to the MIEL in some way. These contributions were all coded as “OY” or leaving the quarter with a positive view of constructivism for urban students. Eight of these Weekly Contributions were about planning for an upcoming lesson and wanting to talk about developing “a constructivist lesson to give kids something different and to challenge them in new ways.” Seven of those eight referred specifically to somehow wanting to incorporate a “real-world situation, like we do for our Everyday Math assignment.” The nine remaining Weekly Contributions were from students who wanted to share a teaching experience in which they tried to use constructivist principles to plan for and implement the lesson. Even students whose lessons “failed” in their eyes were mindful of how difficult a new teaching style can be for students and teachers alike. And how it is

> important to remember that this is a process. I can see that I didn’t like doing math like this in the beginning and it took time to really get why it was helpful and important. I think instruction like this has to be the norm from the very beginning of the year. I don’t think it is at [my urban] school.

Justifying Pedagogical Choices. All 23 preservice teachers had to plan a lesson and justify their choice of pedagogy. Fifteen of them planned for a lesson based in constructivist theory. The remaining eight did not either because their cooperating teachers wanted them to teach something directly from the class textbook, or because they were afraid to deviate from the teacher’s methods for fear of losing students’ attention and respect. Thirteen of the 23 preservice teachers were placed in schools with predominately low-income, African American or Latina/o populations. Of those 13, eight planned for constructivist-based lessons and five did not for the same reasons just mentioned. The comments that follow are exclusively from those students who were in urban schools. Essentially, the preservice teachers who were in urban settings and planned for constructivist-influenced lessons said they did so because they wanted to experience it as a teacher and not just as a learner, and/or because they wanted to try to motivate what were in their eyes apathetic or disinterested students. For instance, an African American woman shared the following:

> For my lesson I am going to use constructivism. I am going to ask kids if they've ever heard of the word probability and what they think it means and when they think it's used. Then I'm going to give them a real situation where probability is important and see if they can solve the problem. I want to try not to just give them a definition of it and then give them problems to do. I'm not sure how this will go over because I have never heard the teacher ask their opinions about math or to tell her something she hasn't told them first. I'm nervous but I'm also excited to try this and to give the kids a different experience.

As noted, preservice teachers who did not plan for a constructivist-oriented lesson were either given the pages from a textbook to cover, or were anxious about students' and their cooperating teachers' reactions to an unfamiliar instructional style. A mature, White woman, wrote:

> I have been taught throughout my studies that often times when schools and students are not meeting state standards, their teachers feel pressure to teach their students through textbooks and worksheets and drills. With such teaching tactics employed, students are more apt to memorize a topic temporarily than they are to gain any deeper understanding of the subject matter. This is not how I want to end up teaching, but this is how my teacher teaches and what the kids are used to. I am going to do the lesson my teacher gave me and teach how she usually does but also think about how I would change it if I were the actual teacher.

Final reflective essay. In the final, reflective essay assignment, 13 preservice teachers who admitted to initially believing that urban children were ill-suited for a constructivist-influenced pedagogy reconsidered this position after having a placement in an urban classroom and planning for and teaching a lesson in such a setting. This change occurred not only for preservice teachers who were able to teach using constructivist principles but also for those who did not:

> I wish I had been able to teach about equalities in a way other than what was in the book. The kids weren't engaged and I had to keep reminding them of which way to put the "mouth of the alligator." I think that if they had been able to come up with their own ways of remembering how to put the signs and why, the whole lesson would have had a different feel and a different outcome. I wish I had taken more risks with the teacher and the students.

Twelve of these 13 students also referred to the MIEL as a significant influence in their changing perspective. For example, early in the quarter many skeptical students cited chronic off-task and recalcitrant behavior in urban children as an impediment to a successful constructivist classroom. Four students wrote specifically about this belief and replaced it with the perspective that such traits likely stem from a disconnect between child and curriculum rather than a demographic identifier. For example, a Latina preservice teacher who was undecided in her initial remarks in Discussion 1 because she did not believe the students in her urban placement could stay interested in a problem for any prolonged period of time, wrote the following:

> I learned a lot about the importance of children connecting with what they're learning. I am at [an inner city] school, and I wish my students could do our weekly math assignment. They just don't see why they have to learn math. When I saw my classmate's example of figuring out how far she needed to walk from the [subway] station to the concert in [the] park, I thought that would be a great problem for my students….The school is right there! I see now that teaching from a textbook is boring for these students because it has no purpose. It scares me to think about teaching in the city without a textbook, but now I see how important it is to have the students learn in constructivist ways.

A different student, whose initial beliefs were also undecided because of his desire for a textbook that would structure and guide his teaching, wrote the following summarizing what he had learned about teaching and learning elementary mathematics:

> I never thought that "real-world" problems needed to be changed for different students. The "real world" is the real world, isn't it? ...It never occurred to me that word problems used in textbooks could be so far removed from so many students' lives. For the first time, I see why constructivism, and having students use their own situations, strategies and problems, would actually be better than using a textbook. Everybody has a different reality.

Discussion

The data reported here describe the constructivist teaching and learning experiences one group of preservice teachers had with the MIEL assignments and how they interacted with them and other aspects of the methods course to change their attitudes and perceptions about the pedagogical needs of urban elementary mathematics students. However, I see the present findings as reflecting the sort of learning paths preservice teachers consistently report and demonstrate from quarter to quarter. This finding is not surprising given that the biases preservice teachers brought to the methods course were consistent with what literature tells us more generally about the beliefs of teachers in urban classrooms.

Preservice teachers who were initially either undecided or skeptical about the value of constructivism for urban classrooms held many of the same conceptions research has found practicing teachers to have. For example, some preservice teachers had the incoming belief that low-income, urban children do not want to learn. This attitude reflects the literature showing that teachers have low expectations of urban students, which typically results in a transmission model of pedagogy that emphasizes basic skills (Zeichner, 1996). Furthermore, many of the preservice teachers' incoming perspectives focused on their beliefs that urban children are difficult to control, present intimidating behavioral challenges, and require more structure than a reform-based classroom can provide. This preconception aligns with the finding that some teachers expect African American students to be harder to control and in need of more restraint in the classroom (Ladson-Billings, 1994). It seems likely that without some sort of intervention in their teacher education program, these preservice teachers could be bound for perpetuating a "pedagogy of poverty" (Haberman, 1991).

Most preservice teachers in this project acknowledged that doing the MIEL weekly led to a reassessment of their perspectives on urban mathematics education. Some spoke about the MIEL as being the only truly constructivist-learning opportunity they had that was not a contrived classroom experience meant to model the sort of reform pedagogy they are encouraged to use in their own teaching. They shared their initial frustrations and ultimate appreciation for the struggles they had in finding their own learning paths and constructing their own understandings not only about mathematics but also about pedagogy. These authentic experiences seemed to highlight and instantiate many of the pedagogical impediments urban teachers and students routinely face.

For example, one paradigm for change was reconsidering the role of a textbook for urban students' mathematics education. Many of the preservice teachers came in assuming that a textbook would provide the scope and sequence for their curriculum and that their role in planning for content and pedagogy would be minimal. However, for many of these students, doing the MIELs and developing confidence with doing, owning, and explaining mathematics was transformative. Thus, they came to appreciate the importance of all children connecting with curriculum in personal and authentic ways. This epiphany was relevant to preservice teachers' attitudes toward teaching children of all demographics. However, it was especially true for their attitudes toward teaching urban children, who most often do not relate to the traditional examples, analogies, and artifacts found in mainstream textbooks (Ninnes, 2000).

This revelation about the need for children to experience a curriculum in authentic ways also had an effect on preservice teachers' initial belief that urban children are far too recalcitrant and difficult to thrive in a constructivist learning environment. This seemed to come about because many of the preservice teachers shared that they initially felt "marginalized" from the methods course curriculum, including the MIEL assignment, because it was not what they expected and they were frustrated by not being told how and what to do. However, as time went on they began to take ownership of and responsibility for their learning and their teaching by doing their own and their classmates' MIELs from week to week.

Consequently, they came to understand why there would be such apathy and resistance among disenfranchised youth who generally do not connect with a textbook curriculum. That feeling of frustration and resistance would never go away. Thus, constructivism became, as one student put it, "not only the preferred pedagogy, but the essential one" for "at-risk" populations.

Concluding Thoughts

In light of research literature pointing to the contrasting quality of education accessible to students from a range of social classes, communities, and cultures, misconceptions about reform-minded teaching and its suitability for urban mathematics classrooms need to be addressed in teacher preparation programs. Although literature, in-class learning opportunities, and field experiences are critical to this education, a more concrete and personal relationship with it in general and urban children's authentic mathematical environments in particular need to be facilitated. Here, a weekly assignment asking students to share, discuss, and explain their day-to-day encounters with mathematics appeared to be influential in fostering at least a rudimentary change in preservice teachers' beliefs about the value of constructivism as a framework for reform in urban elementary mathematics classrooms.

Most of the preservice teachers discussed here made a conceptual shift and came to appreciate that a student population does not frame or limit the efficacy of or need for reform pedagogy. Rather, it is a teacher's commitment to providing an environment that supports rich, conceptual learning opportunities and a direct connection to the mathematics explored that determines a successful school mathematics program. Consequently, they ultimately expressed informed opinions about coming to see constructivism as a model for how people learn and develop regardless of race, class, gender, domicile, or any other demographic descriptor. In effect, the experience of being a constructivist learner in the context of the MIELs was significant for recognizing the value and impact of constructivism for all: "Using the weekly math discussions to examine how I looked at math was very helpful. [The] additional perspectives I got [from] my classmates really helped me too…I learned that constructivism benefits [us all]."

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