Preparing Mathematics Teachers for Elementary High-Poverty Schools: Perceptions and Suggestions from Preservice Teachers

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The National Council of Teachers of Mathematics articulates an ambitious vision of a high-quality mathematics program. Achieving this vision requires competent and knowledgeable teachers who can support all students in learning mathematics concepts with understanding. Effective mathematics teachers are especially needed for high-poverty schools since low-income students score below their peers in all mathematics content areas. This study documents the perceptions of preservice teachers who completed a mathematics practicum experience in an urban elementary school. Problems are identified and suggestions offered by the preservice teachers as they strived to develop into effective mathematics educators at urban high-poverty schools.

The value of learning mathematics in today's global society –a society of extraordinary and accelerating changes has never been greater, and will continue to increase dramatically (National Council for Teachers of Mathematics

(NCTM), 2000). Therefore, the need for mathematical literacy for all students is at critical levels. The National Commission on Mathematics and Science Teaching for the 21st Century (2000) released the Glenn Commission Report, which cited four compelling reasons why all students need to become competent in mathematics and attain substantial understandings in this content area: (a) the pace of change in today's global workplace and economy, (b) the need for mathematics in decision making and problem solving, (c) national security interests and concerns, and (d) the intrinsic value of mathematics education.

Pedagogy and Student Achievement

The National Assessment of Educational Progress (NAEP) mathematics assessment is the only nationally ongoing assessment of mathematics achievement in the United States that gauges student mathematics achievement in grades 4, 8, and 12 (Rampey, Lutkus, & Dion, 2006). NAEP data suggest that urban students are not experiencing instructional practices consistent with the recommendations suggested by the NCTM (Lubienski, 2002).

Wenglinsky (2002) looked at how mathematics achievement levels of more than 7,000 students on the 1996 NAEP mathematics assessment were related to measures of teaching quality. He found that student achievement was influenced by both teacher content background and teacher education or professional development coursework, particularly in how to work with diverse student populations. Students performed better when teachers provided hands-on learning opportunities and focused on higher order thinking skills. Wenglinsky stated, "Regardless of the level of preparation students bring into the classroom, decisions that teachers make about classroom practices can either greatly facilitate student learning or serve as an obstacle to it" (p. 7). Teachers' pedagogical decisions and activities make a difference in students' mathematics achievement (NCTM,

2000). Students' understanding of mathematics is shaped by the teaching they encounter in school (NCTM, 2000).

Analyzing NAEP data, Lubienski, McGraw, and Westbrook (2004) found six factors associated with school experiences related to race/ethnicity: (a) nature of classroom experiences, (b) type of instructional support, (c) amount of instructional support, (d) form of mathematical task, communication, and assessment, (e) types of instructional tools used, and (f) teachers' educational background.

Lubienski et al. (2004) found that race, ethnicity and socioeconomic status are highly correlated. For example, they found that 3% of White eighth graders attend school in which more that 75% of students qualified for free or reduced lunch; however, 34% of Black and 30% of Hispanic students attend such schools. Teachers of Black and Hispanic students lagged behind teachers of White students in instructional support needed to teach mathematics.

They also found that students who qualified for free or reduced lunch and Black and Hispanic students were more likely to be assessed using multiple choice tests than White students. They also found that Black and Hispanic students used computers for drill and practice and White students were more likely to use computers for simulations and demonstration of concepts in school classrooms.

Elementary Teacher Preparation and Pedagogy

Shifts in the elementary mathematics curriculum have led to a substantial increase in the content knowledge needed to teach elementary mathematics (Hill, Rowan, & Ball, 2005). Elementary teachers need not only to be able to teach arithmetic, but they must also be able to teach geometry, algebraic concepts, data analysis, and probability. In addition, they must be able to teach problem solving skills, represent mathematical concepts in multiple ways, connect mathematical concepts within mathematics and to other

subject areas, and be able to analyze students' thinking about mathematics (Hill, Rowan, & Ball, 2005).

Reys and Fennell (2003) found that many preservice elementary teachers were uncomfortable with thinking of themselves as mathematics teachers even though they would be the primary persons who organize and deliver mathematics instruction for elementary school students. These preservice teachers may be uncomfortable because they do understand the mathematics content well, do not know how students learn mathematics, and/or are unable to use instruction and assessment strategies to help students learn mathematics with understanding (Hill, Rowan, & Ball, 2005).

Method

Participants

Forty-two preservice teachers were participants in this study. Among this sample, thirty-four were undergraduate teacher candidates, while eight were graduate teacher candidates. All subjects were female between the ages of 21 and 40, (mean age = 30 years), with 86% Caucasian (N = 36), and 14% African American (N = 6). All subjects identified their socioeconomic level as middle-class or upper, middle class. This was the first urban high-poverty school placement for each of the candidates, although the subjects were three to five years into their teacher preparation program.

All participants were enrolled in an elementary school mathematics methods class which focused on children's developmental levels in learning mathematics, effective mathematical pedagogy and instructional skills, and responding to the needs of diverse student populations. Each candidate was required to complete a 15 hour field-based practicum experience at an urban high-poverty school located within the metropolitan area. Requirements of the practicum field experience included teaching particular mathematics content to individuals and small groups,

developing, implementing, and assessing a prescription plan for students struggling in mathematics, and assessing the effectiveness of their prescription plan.

Three high-poverty, Title I schools with similar demographics and student populations served as the practicum sites, and thirteen classroom teachers acted as practicum supervisors for the study subjects. They were selected by each site's Mathematics Specialist based on scheduling needs of the subjects and no other criteria.

Data Gathering Procedures

The primary data analyzed for this study were responses to the following open-ended written interview questions which were collected at the conclusion of each subject's practicum experience:

- What challenges do elementary teachers in urban schools confront in teaching elementary mathematics productively and with understanding?
- What mathematics instructional practices do you see being used in the classroom in urban schools?
- What do you suggest that teacher preparation programs do to assist you in your development to be a successful mathematics teacher in urban schools?

Data Analysis

Inductive analysis was utilized to examine participants' responses to the written interviews. This method of analysis involved the identification of interpretive themes and categories that emerged from the data (Creswell, 1998; Patton, 1990). The inductive analysis process began with the research team's thorough reading of each written interview to gain a sense of the range of the responses and identify any reoccurring themes. Tentative themes were then refined after

the research team collaboratively reread, reflected on, and discussed each of the subject's written responses.

Results and Discussion

Question 1: What challenges do you perceive that elementary teachers in high-poverty schools must confront to teach elementary mathematics productively, and with understanding?

Preservice teachers perceived six major challenges to teaching mathematics productively. They included: (a) Low Readiness Levels, (b) Low Student Expectations, (c), Student Misbehavior, (d) Lack of Parental Support, and (e) Social Problems. Response distributions are presented in Table 1 below

TABLE 1 *Challenges of Teaching Mathematics in an Elementary High-Poverty School*

Identified Challenges	Response Number	Response Percent
Readiness Levels	40	93%
Expectations	39	93%
Student Behavior	31	74%
Parental Support	29	69%
Social Issues	23	55%

Note: n = 42

The greatest number of responses, (93%) identified student readiness levels and low expectations of urban students (93%) as the greatest challenges facing elementary mathematics teachers in high-poverty schools. Readiness levels encompass the vast array of students' mathematical abilities within one grade level classroom and the teacher's ability to differentiate instruction in order to meet their

individual needs (Tomlinson, 1999). Because students' mathematical cognitive development varies, it is imperative that teachers focus on their pedagogical decisions that benefit all students (Geary, 1996; Mewborn, 2003; NCTM, 2000; Van De Walle, 2007).

Furthermore, according to the NCTM (2000), "All students, regardless of their personal characteristics, backgrounds, or physical challenges must have opportunities to study – and support to learn – mathematics (p. 12). However, meeting this need can be particularly overwhelming for prospective teachers at high-poverty schools. For example, one subject noted:

> *I was surprised that so many students were on different levels to learn particular skills in mathematics. Some students couldn't multiply, and many had difficulty with reading. This made story problems especially difficult. How in the world can I teach two-digit multiplication when so many of the students can't multiply?"*

Another subject articulated her surprise of the readiness levels of fifth grade students:

> *Students in this class are at a much lower level than the fifth graders at a suburban elementary school located in a neighboring city]. I only observed a few [students] who I would consider being at grade level.*

Equally challenging is the lack of behaviors demonstrated by practicum supervisors that promote high-expectations (93%) of urban students. Teacher expectations are demonstrated through a vast array of specific teacher behaviors, categorized under three strands: (a) Personal Regard, (b) Response Opportunities, and (c) Feedback (Brophy & Good, 1986). For example, taking an interest in

students' personal lives and providing equitable response opportunities are behaviors that promote high expectations, and are categorized under Personal Regard and Response Opportunities, respectively. According to Lavoie (1996) and Haberman (2005), many teachers in high-poverty schools often "give up" on challenging students; they tend to blame the student for their failures, instead of taking responsibility for their own inability to effectively teach them.

Many participants noted some alarming behaviors demonstrated by their practicum supervisors that communicated low student expectations:

> *Within five minutes upon entering the classroom, I knew who all the bad students were. The teacher had them sitting in desks facing the wall in back of the classroom.*

And yet another said:

> *I don't think my teacher or the students like being here. It's not a happy place.*

Student behavior (74%), parental support (69%), and social issues (55%) were also identified as challenges to teaching mathematics in urban schools. Many subjects noted the amount and range of discipline concerns and the impact these behaviors had on the overall climate of the classroom, especially as it relates to instruction. For example:

> *I'm surprised the teacher got anything done during their math period. Joseph continually left his seat, and disrupted the other students. He didn't even attempt to be quiet. The teacher ignored him at first, and then they both got into an argument. I can't believe how Joseph talked to Ms. James (Cooperating teacher, a pseudonym).*

Managing student behavior is a particular concern for a vast majority of urban teachers. Haberman and Richardson (1990) reported that discipline problems of students are a leading cause for teacher attrition in high-poverty schools. Haberman (2005) and the Alliance for Excellent Education[AAE] (2002) also reported that problematic student discipline continues to be a major factor impacting teacher retention.

Many of the subjects commented on the lack of parental support and the debilitating conditions in the students' community. For example:

> *Í can't believe the conditions in the neighborhood, and how people can live there. Now I see why they have low test scores.*
>
> *The students are just so needy, and the atmosphere is so demanding. I'm not sure if I would ever want to teach here.*

Overall, the subjects' responses may indicate a lack of compassion or cultural understanding involving the dynamics of high-poverty areas and schools. The majority of the sample was composed of White, middle-class women (n = 36; 86%), whereas the student population at their practicum sites were students of color and from lower socioeconomic levels. This alone has serious implications; the subjects may have developed negative or distorted beliefs, attitudes, or understandings whether at the conscious or unconscious levels, about race, culture and context (Darling-Hammond, 2002; Gay, 2000; Kincheloe, 2004; Haberman, 2005; Ladson-Billings, 1994).

The challenges that participants identified are typical of urban schools (Brown, 2002; Haberman, 1995 & 2005; Kozol, 1991; Ladson-Billings, 1994; Thompson, Randell, Rousseau, 2005). High-quality teachers are able to overcome the challenges of urban schools and achieve success

(Haberman, 2005). Therefore, it is imperative that preservice teachers be paired with supervising teachers who are successful in this urban, high-poverty environment.

Question 2: What mathematics instructional practices do you see being used in the classroom in high-poverty schools?

Two broad themes emerged from the data: (a) lecture, or teacher directed, and (b) constructivism, a hands-on approach.

Lecture, or teacher-directed instruction, was observed by 27 of the subjects (64%) and constructivism was observed by 15 of the subjects (36%). Although lecture was observed by a greater percentage of the subjects, it's not necessarily the best approach to teaching mathematics (NCTM, 2000). Response distributions are presented below in Table 2.

TABLE 2 *Current Mathematics Instructional Practices*

Identified Practices	# of Responses	Percentages
Lecture, Teacher Directed	27	64%
Constructivism, Hands-On	15	36%

Note: n = 42

The National Council of Teachers of Mathematics (NCTM) introduced the *Principles and Standards for School Mathematics* (2000) which reflects the basic precepts that are essential to providing a high-quality mathematics instructional program. Exposing students to authentic, attention-grabbing, mathematics activities that will spark greater interest and understanding of mathematics is the new direction called for by the NCTM (2000). However, many mathematical classrooms continue to use antiquated instructional practices that are far removed from the

researched-based pedagogy currently advocated (Mathematical Association of America (MAA), 2001; NCTM, 2000).

Lecture or teacher-directed instruction can viewed as programmed instruction where drill and practice are a major component (Cathecart, Pothier, Vance, Bezuk, 2006). This methodology was observed by 27 of the subjects (64%) as their supervisors' main approach to teaching mathematics.

> *My supervisor used the same old approach that my teachers used when I went to school.*
>
> *All I ever see is worksheets. The students are so bored with them.*

Educational research from the past 60 years supports the notion that drill and practice alone does not guarantee mathematical understanding and immediate recall. Student competence or mastery of a particular concept or skill does not necessitate extensive drill and practice activities (Bjork & Drunckman, 1994; Hiebert, 1990)

Constructivism, or mathematical knowledge constructed by through interactions of the students and teacher, is considered a more hands-on, student-centered instructional approach (Cathecart et al., 2006; Cobbs, Yackel, & Wood, 1991; Davis, Maher, & Noddings, 1990; Goldin, 1990; Yackel & Cobb, 1990). Constructivists believe that students must play an active role in developing mathematical understanding, rather than receiving information from the teacher (Cathcart et al., 2006). Manipulatives play an instrumental role in assisting students to develop a conceptual understanding of different mathematical concepts and skills. Research indicates that instruction that centers on the use of manipulatives produces greater mathematical gains and achievement when compared to instruction not utilizing them (Fuson & Briars; 1990; Suydam & Higgins, 1977; Wearne & Hiebert, 1988).

During their practicum, participants noted differences between constructivist and teacher-directed classrooms and described the constructivist classrooms in this way:

> *The students were really involved. Although it was loud at times, they were really getting it [concept being taught].*

> *The teacher really created an engaging environment. Students were talking to each other and the higher students were helping those at lower levels. She posed real life problems for the students to figure out as they worked with the manipulatives.*

The fact that a higher percentage of the subjects observed mathematical instructional practices that many view as outdated, ineffective, and not student-centered raises concerns. Haberman (2005) asserts that urban teacher preparation requires extensive field work under the direction of effective teachers, whose task is to model best practices. Because field experiences and cooperating teachers (practicum supervisors) have such a significant impact and influence on the development of future teachers, an influence that can extend to the first three years of teaching, it is imperative that they be presented with best teaching practices and pedagogy **(**Tabacbnick & Zeichner, 1984).

Question 3: *What do you suggest that teacher preparation programs can do to assist you in your development as a successful mathematics teacher in a high-poverty school?*

Three recommendations emerged from the data: (a) More experiences in urban schools (100%), (b) Pairing with high-quality teachers (83%), and (c) More focus on understanding the dynamics of high poverty schools (71%). Subjects' response distributions are provided in Table 3.

Field experiences in the classroom setting are a critical component of teacher development (Darling-Hammond, 2005; Dewey, 1938; Gallego, 2001). They provide opportunities for the preservice teachers to explore and practice mathematical teaching strategies, make connections from mathematical theory to practice, and to understand

TABLE 3 *Recommendations for Teacher Preparation Programs*

Recommendations	# of Responses	Percentage
More Urban Field Experiences	42	100%
Effective Supervisors	35	83%
Focus on High-Poverty Schools	30	71%

n = 42

student's mathematical development. Not only do preservice teachers need to develop the necessary skills and knowledge to teach mathematics with understanding, they must also develop an understanding of teaching mathematics in a school culture that is often new to them. All the subjects (N = 42; 100%) identified the need for more urban high-poverty school field experiences. Additionally, 71% of the subjects (N = 30) stated that more opportunities to understand the culture of high-poverty schools need to be provided.

The literature reveals that student teachers often attribute their instructional methodology and dispositions to their cooperating teacher, more than to their teacher preparation coursework (Conderman & Pedersen, 2006; Fairbanks, Freedman, & Kahn, 2000; Richardson-Koehler, 1988; Smagorinsky, Cook, Moore, Jackson, & Fry, 2004). Teaching in an urban environment was a new experience for the subjects, and therefore, the need to be placed with

effective teachers to assist and guide them in understanding the students, school, and community, as well as aligning their pedagogical practices with the cultural experiences of the students is of utmost importance.

Summary and Implications

This research focused on 42 preservice teacher's perceptions of teaching mathematics in a high-poverty, urban elementary school setting. These preservice teachers provided suggestions for teacher education programs as they struggled to develop into quality mathematics teachers for urban schools. The subjects identified several challenges for teaching mathematics with understanding in urban schools. The challenges they identified are typically associated with high-poverty schools—student misbehavior, low student expectations, and societal problems (Kopetz, Lease, & Warren-Kring, 2006; Kozol, 1991; Haberman, 1995, 2005; Olson & Jerald, 1998).

While the literature reports that many teachers may not have the necessary mathematical content knowledge to teach with understanding (Mathematical Association of America, 2001; NCTM, 2000), the preservice teachers in this study did not identify this as a particular challenge. The challenges they identified had more to do with teaching in an urban school than with teaching mathematics. This is especially significant since *No Child Left Behind* emphasizes content knowledge test scores (PRAXIS I and II) as the means to define "highly-qualified" teachers without addressing the skills, knowledge, and dispositions needed by teachers to meet the demands of urban teaching (McKinney, Fuller, Hancock & Audette, 2007). Once these teacher candidates have a better understanding of working in urban schools and with low-income students, further research is needed to determine if they experienced challenges specific to mathematics content and its subject specific pedagogy.

It is worth noting that the perceived challenges of urban teaching should be addressed in teacher education programs (Claycomb, 2000). If preservice teachers' perceptions of urban teaching are not positive, they may not consider accepting a teaching position in urban schools. Realizing that not all teacher candidates have the ideology or dispositions for urban teaching, negative perceptions of urban schools may discourage those candidates who otherwise would make excellent candidates for teaching in this setting. The work of McKinney, Haberman, Stafford-Johnson & Robinson (2006) confirms this notion. Although their research focused on student teachers, they concluded that if student interns felt they were not successful during their urban internship, they may be less willing to accept an urban teaching position.

Wilson, Floden, and Ferrini-Mundy (2001) conclude that there is a lack of knowledge and expertise in how to best prepare urban teachers. This study's subjects offered suggestions for preparing urban teachers including: (a) more urban mathematical field experiences, (b) placement of preservice teachers with effective urban mathematics teachers, and (c) teaching about cultural understandings necessary to cope with the complex realities of urban teaching. Again, the subjects focused on the 'urban' aspect of the practicum and not the teaching of mathematics or mathematical content knowledge.

Traditional teacher education programs may not provide quality urban field experiences or experiences that provide preservice teachers with a cultural understanding of urban communities, schools, and students. Additional research needs to be conducted to determine what constitutes a quality urban field experience (Wilson, Floden & Ferrini-Mundy, 2001). Quality mathematics field experiences must occur under the supervision of effective teachers – teachers who will model best practices and behaviors. The data may suggest that teacher preparation programs may need to play a more instrumental role in the selection of practicum supervisors to assure preservice teachers are placed with

effective teachers. Additionally, criteria may need to be developed to define effective urban teachers.

Many of the current subjects witnessed instructional practices by their practicum supervisor that were not aligned with the *Principles and Standards for School Mathematics* (NCTM, 2000). Because of the instrumental role cooperating teachers play on developing novice teachers, they need to model instructional strategies that are standards-based (Tabacbnick & Zeichner, 1984). If practicum supervising teachers can not or do not do this, it may be beneficial for the preservice teachers to be provided with mathematics specialists to model standards-based practices for teaching mathematics with understanding. A mathematics specialist serves as a support for teachers and administrators who want to examine instructional practices within their schools so that they can work to improve mathematics teaching and learning (Nickerson & Moriarity, 2005). As such, they might be able to play an instrumental role in developing preservice teachers for mathematics instruction in urban settings.

The literature has made clear that the quality of a mathematics teacher is a strong predictor for student achievement in mathematics (Boaler, 2006; Hill, Rowan, & Ball, 2005; Sutton & Krueger, 2002). Because of the disparities in the mathematics achievement between minority and majority populations (NAEP, 2002), the need to provide highly-qualified mathematics teachers for high-poverty schools has reached critical levels. Providing carefully-planned mathematical field experiences for preservice teachers can be one approach to prepare urban educators. However, the data from this investigation suggest that certain factors such as understanding the culture of urban, high-poverty schools and being placed with effective urban mathematics teachers are of utmost importance for providing preservice teachers with a quality experience. After all, all students are entitled to a world-class mathematics education program (NCTM, 2000).

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