So When Do We Teach Mathematics?
Vital Elements of Professional Development for High School Mathematics Teachers in an Urban Context

By Nancy Brown & Babette M. Benken

It is our belief (university professors/researchers), and the finding of many studies, that effective professional development can be an invaluable foundation for high-quality, reform-oriented teaching that leads to improved student learning and achievement (e.g., Darling-Hammond, 2000; US Dept. of Education, 2000). Furthermore, teachers serve as the primary catalyst for change in students' learning (Borko & Putnam, 1995). However, given the plethora of research and anecdotes related to successful programs that ultimately lead to student achievement, how to design professional development within a given context remains a challenging endeavor.

Research suggests the following be included in successful professional development efforts: (1) university and school collaborative partnerships, in which teacher educators play an important role in the development of teachers' thinking and independence (Little, 2002; Putman & Borko, 2000); (2) opportunity for teachers to reflect in a collaborative format (Farmer, Gerretson, & Lassak, 2003); (3) guided help with the

Nancy Brown is an assistant professor in the Department of Teacher Development and Educational Studies at Oakland University, Rochester, Michigan. Babette M. Benken is an assistant professor in the Department of Mathematics and Statistics at California State University, Long Beach.

study of curriculum, assessment, and instruction (Newmann, Secada, & Wehlage, 1995); (4) modeling of practices that promote effective student learning; and (5) opportunities to negotiate learning within the context of the teachers' own practice and classroom (Wilson & Berne, 1999). Although there exist lists of what should be incorporated in professional development programs, rarely does this literature explore how to embed these components within the realities of the urban school context.

Teacher development is further complicated by the federal- and state-level expectations for teachers to become *highly qualified* (No Child Left Behind, 2001). Mandates emphasize content knowledge and make it imperative for all teachers to have an opportunity to work toward initial and continuing certifications within a unified program. Within content knowledge, mathematics is identified as an essential component of K-12 teachers' foundation (U.S. Department of Education, 2003). Thus, within professional development, there must be more emphasis on mathematics content knowledge.

Teachers' thinking about mathematics teaching and learning are challenged by expectations and ideals endorsed by current reform efforts in mathematics education (e.g., NCTM, 2000). Such recommendations call for an approach to mathematics teaching that allows students to communicate, problem solve, and engage in conceptual mathematics. Teachers are asked to teach in ways that promote an integrated, connected view of mathematics, rather than a procedural, rule-based view. This shift toward inquiry-based instruction assumes teachers view mathematics as a tool for thought, rather than a set of rules and procedures to be memorized. However, teachers are unlikely to make adjustments in their thinking without intervention and deliberate support (Richardson & Anders, 1994). Given this understanding, professional development efforts must intentionally provide experiences that will assist teachers in learning new ways of thinking about mathematics and its teaching (Farmer, Gerretson, & Lassak, 2003).

Within a stronger focus on content knowledge, programs must also examine the type of mathematical content that is explored, as well as the explicit links they make to pedagogy. Hill, Rowan, and Ball (2005) found that "teachers' mathematical knowledge was significantly related to student achievement gains" in elementary classrooms (p. 371). Ball, Lubienski, and Mewborn (2001) cite the importance of *knowing mathematics for teaching*, which encompasses all of the knowledge required to teach mathematics effectively. From a professional development standpoint, this perspective suggests that programs should provide opportunities for teachers to learn mathematics around specific content and teaching situations that may arise in practice.

Designing professional development becomes increasingly complex when layered with issues specific to inner-city settings. In urban schools, teachers often avoid teaching that requires students to use higher-order, critical thinking (Walker & Chappell, 1997). Given the focus on problem solving in reform-oriented approaches to learning mathematics, this propensity towards procedural mathematics

does not provide students with learning experiences that can allow them success on required, high-stakes tests. As Walker and Chappell (1997) state, "The question is not whether urban school students can or cannot achieve mathematical skills; rather, it is which *means* will elicit maximum success in mathematics" (p. 202). What is clear in the research on mathematics teacher education is that without on-going professional development that addresses teachers' understandings of mathematics and supports their efforts to improve practice within their own classrooms, no gains can be made in students' mathematics achievement (Ball, 2000).

This article explores central elements that facilitate successful mathematics professional development in urban secondary schools through a case study of one long-term effort. The following research question guided this study: How can we structure professional development that supports teacher learning and addresses the complex realities of urban practice?

Methods

Context

This study took place in an urban school (The City School [pseudonymn]: 1,500 students, grades 6-12) located in a large city. Most of the student body was minority (99.8% African American) and considered underprivileged (according to government *free and reduced lunch* records). The City School articulated a focus on increasing student achievement and preparing students for post-secondary education. To support this mission, the school administration kept the student-to-teacher ratio to 22:1. The City School was concerned about its students' learning and interested in on-going professional development with our university.

In spite of The City School's commitment to its students, our shared perception was that it was facing a dire situation. This school suffered from high teacher turnover, with many (72%) teachers at the time of this study (2005) having not yet completed state-level certification, including passing the required mathematics examination. In 2004 over 75% of students were unable to pass the standardized, state-level mathematics assessment, with scores having declined since 1999. It was perhaps partially due to The City School's critical circumstance that the administration and faculty were eagerly responsive to on-going professional development that focused on increasing faculty knowledge leading to student achievement.

Previously, The City School had made a proactive attempt to improve scores through isolated, short-term in-service presentations. These attempts had no documented or visible results, according to the administration and test scores. This approach does not allow teachers to address misconceptions, construct new orientations, and learn to teach for understanding (Darling-Hammond, 1997, 1999; Miller, 1998). Hence, to facilitate growth in teachers' knowledge and beliefs, our professional development intervention was long-term and incorporated the teachers' understandings through practice-based discussions.

Researchers as Participants

Our university approached us (at the request of The City School administration) to examine current mathematics curricula and professional development attempts. We eagerly became involved, as we are genuinely passionate about student learning and working in schools. What has made this work both interesting and possible is that we, at the time of this study, were housed in different units within the same university (a school of education and a department of mathematics in arts and sciences), yet were connected by our common perspectives related to teacher education and the important role a teacher can play in transforming K-12 schooling (Borko & Putnam, 1996). Having worked in urban, K-12 schools as both teachers and administrators, we both value the practice of teaching as a demanding calling that requires both a strong desire to educate others and a complex set of knowledge and skills.

Our university is state supported and located in a suburban, Midwestern community; its teacher education program is considered substantial, with more than 300 students graduating each year. After consultation with The City School's administration about their academic situation, we developed a long-term, on-site professional development effort. We, both female and Caucasian, planned, researched, and taught within this effort.

Teachers as Participants

Participants included three high school mathematics teachers (female, African American), all of whom had undergraduate degrees in mathematics but did not yet hold teaching credentials. Participation was voluntary; the three participants represented half of the high school mathematics teachers, indicating certification demands as the central motivator for participation.

The participants all came to teaching for very altruistic reasons. They previously held successful jobs in the business sector, yet after only a few years felt as though they were not significantly contributing to society; they chose to become teachers to help others with a genuine desire to help their students achieve personal and academic success. Participants considered themselves *good* teachers and were extremely popular with students. They attributed the lack of student academic success to their students' difficult life situations. Participants communicated that they were eager to begin our work, as they wanted to genuinely improve their teaching, while simultaneously earning graduate credits toward a credential. They expressed a sense of urgency, as The City School administrators had warned them that due to external demands, they would lose their jobs if they did not complete a certification program within the next two years.

Professional Development Design

Based on the current research recommendations outlined in the previous section, we (researchers/instructors) instituted an on-site program that involved us collaboratively teaching two integrated courses: one in mathematics—"Algebra and Functions

for Secondary Mathematics Teachers"—and one in general pedagogy—"Instructional Design and Assessment." We designed these courses based on participants' pre-assessments (content exams, surveys), classes they were currently teaching, district curriculum, and content embedded within state-mandated standardized assessments (e.g., functions). These small, tutorial-style courses met weekly over the course of one school year in a collaborative forum where the participants could share ideas about teaching in conversations that were grounded in their actual practice.

Our three primary course goals were to facilitate: (1) participants' growth in knowledge (content, pedagogical, pedagogical content); (2) their transformation in beliefs relative to content and pedagogy; and (3) the generation of a community of practice (e.g., Palincsar, Magnusson, Marano, Ford, & Brown, 1998) that would be authentic to both participants' expectations and context. Related to content, we implemented an approach that addressed national recommendations, which involved having participants communicate, problem solve, and be active in the learning process. We wanted participants to engage in the mathematical concepts and view them as connected and relevant to everyday life, rather than as a set of rules and procedures to be memorized. We aligned the goals and instruction in these courses to reflect our common orientation toward teaching and teacher education, which included active knowledge construction, opportunities for on-going reflection, a focus on enduring mathematical understandings, alignment of course goals with authentic activities (e.g., Stein, Smith, Henningsen, & Silver, 2000), and modeling teaching practices that supported these tenets.

Data Sources

Data were collected throughout the 2004-2005 school year. Data sources included: transcripts of audio-taped instructional sessions (30) and informal meetings (10), researcher field notes of all sessions and meetings, transcribed formal interviews (3) with participants, participant journal entries and course assignments (e.g., content exams, problem sets, narrative reflections, lesson design), initial surveys and end of program evaluations, observation field notes of participants' practice (five per participant), e-mail correspondences, and researcher journals.

We conducted semi-structured interviews (30-45 minutes) with participants at the beginning, middle, and end of the project. Initial interviews centered on participants' responses on open-ended surveys. Survey questions asked participants about their educational and teaching backgrounds, role within the school, beliefs about students, mathematics, and teaching, expectations for the experience, and why they had chosen to teach secondary mathematics and in an urban setting. Middle-of-program interview questions asked participants to reflect on their learning and continued expectations of the professional development experience. End-of-program interview questions were similar in nature to those in the middle of program; however more questions asked participants to reflect on their experiences and perceptions of the impact of the professional development program on their learning and practice.

To understand participants' practices we observed each participant five times over the course of the year. For each participant, we chose to spread observations across different courses to determine if practice differed by content/students, with the final observation occurring in the same classroom as the initial visit to determine possible subtle change in practice.

Analysis Approach (Three Phases)

First, we analyzed all data using *direct interpretation* (Stake, 1995) to understand the substantive changes within participants' content knowledge and practice, as well as the role that the professional development experience and context played in those changes. We looked for themes at the level of participant (based on pre-post comparisons, frequency made in statements, and level of importance to participants). Coding illustrated effectiveness of program through an analysis of focus and duration of course meetings, content of course assignments and participant dialogue, and researcher reflections on programmatic decisions.

Second, we aggregated data across participants to understand their perceptions of the role the professional development effort played in their growth. Finally, we did an analysis across the entire year of professional development to determine impact on long-term growth, as well as an articulation of how this program evolved over the course of the research project.

Validity issues were addressed by member checking, triangulating data, coding independently by two researchers, and the long-term nature of the project. Reliability was enhanced by the researchers keeping separate journals throughout the course of the project and its planning, in which they recorded personal reactions to the professional development experience, emergent ideas, possible related literature, ethical considerations and dilemmas, and general perceptions of participants and the impact of program.

Results:

Foundational Emergent Finding—

The Dilemma

Early in this work we recognized that the participants were faced with daily professional struggles (e.g., poor student attendance, student drug abuse and criminal activity, moving classrooms during first week of classes) that prevented them from actively engaging in stated course content. We grappled with how to address participants' seemingly on-going needs and practical problems, while maintaining an effort that would facilitate growth in mathematical understandings and practices. Our work thus expanded to include a reconceptualization of our process and what could be realistically achieved (Loughran, 2004).

What became apparent after the third session through our analysis of transcripts

and field notes was a conflict between our original intentions for the experience and the in-class outcomes. Simply stated, we became frustrated that at least half of each group meeting centered on what we judgmentally viewed as the participants' "griping" about their experiences within The City School (e.g., all-school announcements interrupting class, students living as independent adults with no supervision, and required administrative duties during class time); these conversations resulted in the content of our planned lessons being largely ignored. Our new dilemma became, "So when do we teach mathematics?"

Although addressing the participants' immediate school needs became our choice, we sought to understand why we were making this choice and how we should resolve our new dilemma of helping the participants in a way that would be responsive to each participant's state of mind. At this point we moved from examining growth in content understandings and practice to pondering our troubling situation.

To this end, we looked for patterns within our field notes, observation transcripts, and interviews. Through this process of analysis we wanted to learn both what was preventing these teachers from engaging in the content aspect of planned lessons on mathematics and pedagogy and how we could address this cause through the redesign of our courses. It became important to understand the voice of these teachers and their either conscious or unconscious choices as participants in this program. If not mathematics, what were these teachers learning, and what was preventing them from engaging in the content of our professional development? Before we could begin to answer our initial research question, we first had to examine how to transition the existing situation to the goals of our professional development. Therefore, we completed the study with now two research questions: (1) What was preventing these teachers from engaging in planned lessons?, and (2) How can we structure professional development that supports teacher learning and addresses the complex realities of urban practice?

Results:
Subsequent Findings—
Answering the Research Questions

Research Question #1:
Impediments to Engagement

Data analysis revealed that there were four main impediments to participants fully engaging in the professional development: (1) the way in which the participants negotiated the intricacies of the context—*context*, (2) the complexity involved in being an adult learner of mathematics—*adult learner of mathematics*, (3) the view participants had of their role as professionals within their context—*professional identity*, and (4) the perceptions participants held of our level of commitment to and understanding of both their context and the life of a teacher—*shared trust*.

Teacher dialogue captured in data revealed that how participants reacted to two components of the context, school and community, played a key role in their ability to come prepared to engage in lessons. Understanding the impact that these layers played in the participants' lives and their inability to accommodate these external pressures provided a foundation upon which we could develop our working relationship (Sarason, 1996).

School context. Participants were very upset about their perceived lack of administrative support, as well as frequent changes made by the school administration. For example, prior to beginning the program, we established a schedule for our on-site course meetings with both the teachers and central office (curriculum director and superintendent); it was suggested by upper-level administration that we meet during the participants' already scheduled professional development time. However, once our meetings began, the principal (their immediate supervisor) informed the participants that they could not attend their university course meetings during these blocks, as she wanted them at her staff meetings. As one teacher wrote in her journal, "I just don't get them. They are always contradicting and one-upping each other. Why are they making this so difficult?" This apparent power struggle and/or miscommunication between layers of administration caused great unrest and frustration for participants.

A second example was the participants' aggravation over having to, once again, move rooms during the first week of classes. For the past three years participants learned upon arriving back to school that the organizational structure within the building had been changed. During this fall semester they were being moved back to being separated by grade, as opposed to content area. The participants communicated that they were not provided justification for this change, nor were they consulted. The outcome of this change was that even by October, participants were still trying to shuffle their course materials across the building. Both of these examples represent the many situational factors that the participants perceived as impeding their ability to focus on their practice and the professional development program.

Community context. Participants were also very concerned about many of their students' nonacademic needs and, as a result, often came to our course meetings unable to focus on our objectives. For example, one of the participants told our group of a female student who had been rude to her during a class earlier in the day of our meeting. As she explained, "Can you believe that she called me a xxx? But, what would you expect? She's in a very difficult situation. But, she has to respect that I'm her teacher." What we found interesting and poignant was that in the same breath she also spoke to her concern over this student's situation; the student was living with her boyfriend because of dire problems at home. The boyfriend had been in and out of jail, causing this participant to really worry about her student's well being. Our conversation ended with the participants conjecturing that this student must have considered herself an adult and therefore approached her teachers as

peers in dialogue. Although this was a wonderful learning experience for our community, it did not further our goals concerning mathematics.

The participants' concern also extended to disruptions to students' learning. For example, in late September, all of the participants expressed frustration over students still being pulled regularly from their classes to complete paperwork for new identification cards. As one participant said during a class meeting, "Why could this not have been completed by the second week of school? Haven't they [administration] yet figured out how to handle this situation without disrupting our class time?" This example is one of many illustrating procedural decisions that participants saw as directly disruptive to student learning. Although our discussions about these types of concerns prevented us from attending to our agenda for the participants' learning, they provided us a vehicle through which we could better understand participants' situations and perspectives. Participants were clearly frustrated about aspects of their context, but underlying this frustration was a genuine concern for their students' academic and physical wellbeing.

Adult Learner of Mathematics

Data revealed that all participants diverted conversation more during mathematical lessons within the professional development program than in discussions that centered on how to best design a lesson or assessment. Through our on-going process of analysis, we began to suspect that participants had generated defensive facades to prevent others from realizing their lack of conceptual content knowledge (mathematics). One glaring finding supporting this conjecture was that by week six, the instructional design and assessment part of the course was back on schedule; however the content piece was more than three weeks behind. We did not find it merely a coincidence that participants suddenly had "major school obligations" or a "crisis" during meetings that focused on exploring mathematical concepts.

Given the national- and state-level recommendations for an approach to mathematics teaching that allows students to communicate, problem solve, and engage in conceptual mathematics, it was critical that we address participants' content knowledge. Although we knew from pretests that all participants had gaps in their understanding of secondary mathematics, we began to suspect that they suffered from anxious attitudes toward mathematics that supported their fear of others learning of their gaps in understanding. Research reveals that math anxiety exists among teachers, particularly at the elementary level, and influences practice (e.g., Cohen & Leung, 2004; Hembree, 1990). Having worked with prospective mathematics teachers at the secondary level for years, we understood that they could have considerable gaps in their mathematical understandings, particularly with elementary concepts (Frykolm, 2000). However, we were taken aback when these high school teachers exhibited what appeared to be symptoms of math anxiety (e.g., unwillingness to complete math homework assignments, avoidance of participating in collaborative problem solving) to the level that prevented engagement in mathematical lessons.

Given what we understood about participants' content knowledge and position within the school, we began to acknowledge and explore possible origins of the complex, context-dependent nature of being an adult learner of mathematics.

Professional Identity

What appeared to be intimately connected with participants' views of themselves as learners of mathematics were their views of themselves as teachers and what constitutes good teaching. Participants saw themselves as present in the school to make change and help students. They spoke of their goals relative to improving students' emotional and circumstantial needs, as well as helping the administration to set long-range improvement plans. What was missing from this set of noble goals, however, was discussion of their professional mission in terms of how to best teach mathematics. For example, one participant eagerly shared that her primary goal last year was to "build rapport" with students; she achieved this goal by opening her room to students during lunch to "chat about the students' lives." Another participant during one of our informal meetings shared that, as the head of the math department, she had to speak with another teacher, whom she did not perceive to be engaging in good practices. When we probed what gave her this view of Teacher X, she explained that Teacher X did not appear to "connect with students," as this teacher never seemed to know about students' problems outside of the building.

The immediacy that participants perceived in these circumstances overshadowed attention to academic needs. For example, they addressed how to help students achieve mathematically only when prompted by us during discussions. We conjectured (confirmed by participants' journals) that participants' concerns for their students' affect were not allowing them to pay explicit attention to how their own learning of mathematics and new pedagogy impacted their students' learning and achievement. This understanding illuminated the powerful role that professional identity can play in the learning of content and practice (Alsup, 2006).

Unexpectedly, analysis of discussions revealed that school context was a uniquely strong influence in the development of participants' professional identity. Within this building these participants were deemed as master teachers; in particular, one of the teachers, even without state certification, was placed in the role of Department Chair and another was put on the School Improvement Team. So, on the one hand, participants were publicly recognized by administration as being strong teachers. On the other hand, they were also encouraged to engage in our program to obtain certification and told daily that students' standardized mathematics assessment scores must improve. This dual message resulted in participants forming a professional identity that stemmed from competing forces of maintaining the public perception of mastery, while simultaneously trying to figure out how to engage students and help them to learn. How content knowledge was negotiated within participants' professional identities became imperative to moving forward with their professional development in mathematics.

Shared Trust

Our work together began with participants viewing us as respected educators, who were in their building to help them get certified. Although a level of respect existed, it was not well understood by either group and was too superficial to support a productive working relationship that incorporated the realities of the context. Our initial finding revealed that to move forward with the professional development experience we needed to meet participants where they were in their thinking about teaching mathematics within their school; in essence, we needed to better understand these teachers and their thinking.

Early in the program we tried to communicate to the teachers that we genuinely cared about their experiences and students. In finding a common ground we came to recognize that these teachers needed to also know us as human beings, as well as educators who had years of K-12 teaching experience. Building a relationship based on shared trust was initially undermined by a number of factors that could be characterized as power structures. For example, we were two white women in a building that was 100% African American. We both held doctorate degrees, as well as teaching credentials, and the participants were struggling to complete initial certification. We were also researchers, and, from the participants' perspective, could have been seen as analyzing them through a looking glass. Initial analysis of transcripts supported our working theory that participants sometimes elaborated somewhat shocking school stories to gage our reaction and perhaps even test our ability to understand their day-to-day reality. We found we often responded by recounting our successes and failures with students, whom we had taught in inner-city settings years before. In essence, we proved to these teachers that we held our own "war stories," could empathize with their stories, and were committed to helping them move forward in ways that made a difference for these teachers in their context.

As time progressed, transcript data revealed increasingly less formal conversation relative to both content and manner of address. For example, during initial meetings we addressed each other formally as was done at The City School; we were "Dr. A and Dr. B" and we referred to them as "Ms." By the third month of meeting we were all on a first name basis. Perhaps prompting this change was the participants sharing their personal lives with us and asking about ours. For example, participants were unitedly working on weight management, and they would share their new diets and results with us. Soon we were all laughing about the possible addition of chocolate as a food group. Another example surrounds a family situation that happened to one of us—the illness and subsequent death of one of our mothers. The teachers asked about this situation during every meeting and often sent supportive emails. These examples speak to the creation of an achieved level of comfort, liking, and trust, which data revealed developed over time; it also correlated with the participants' ability to open up and share their insecurities about their school experiences, understanding of mathematics, and openness to exploring and implementing new pedagogy. By the end of four months, we had caught up

with the mathematics curriculum and were now able to engage in practice-based conversations about learning and teaching mathematics.

Research Question #2:
Vital Elements of Urban Professional Development

The following are the three primary foundational structures that proved to be vital in supporting participants' learning of both content and pedagogy in our professional development program: (1) development of a context-embedded relationship among all constituents; (2) contextualization of mathematical content; and (3) negotiation of professional identity.

Development of Context-embedded Relationship

Perhaps the most fundamental change occurred within the first two weeks of this experience. Upon our recognition of the amount of time spent on the participants' venting their concerns over student and building issues, we immediately questioned our role within this professional development community. We needed to be genuinely emotionally involved in the participants' feelings and needs before we could understand how to better guide the meetings in ways that would eventually lead to lessons on mathematical content and lesson design/assessment. First, we both had much experience in urban schools and needed to communicate our shared concerns over participants' students and building environment. Second, through this process we became better listeners, who were now able to reflect on how to more closely align all aspects of the professional development with our stated goals.

We soon recognized that before we could move to planned lessons on design, assessment and mathematical concepts, we needed to restructure sessions so that we could move participants past their level of frustration to a more open learning-centered frame of mind. To begin, we repositioned some meetings out of The City School (e.g., restaurant in the downtown area near the school) with the sole intention of opening the discussion, not having an agenda, and allowing for personal sharing and trust building. Additionally, our lessons now began with an agreed-upon 15-minute period of open discussion. This shared discussion time revealed to participants our acknowledgement of their needs, as well as validation of their experiences. Simultaneously, there was an acknowledgement of our needs, as researchers and members of a university community, trying to accomplish an agreed-upon goal of school improvement. In essence, we found it necessary to set some parameters that would enable sharing, yet at the same time, restrict it, as well as make sure this sharing time nurtured two-way communication.

The final area in which we proactively made change was in our level of involvement within The City School. We began working collaboratively with on-site administration to make changes they deemed necessary within the building. As part of this expanded role, we revealed our genuine dedication to improving The City School, as well as modeling for participants how they could serve as change

agents. During end of program interviews, one participant explained how our modeling helped her to transform her approach to serving as Department Chair. For example, she believed that when we analogized departmental leadership as facilitator of shared responsibility, she began to view her position as more than merely an organizer of schedule and load. Additionally, we transitioned to spending more time with participants in the building outside of our planned meetings. For example, we helped participants to implement lessons based on course learning, as well as attended faculty meetings on curricular reform.

Building on our common ground based on trust, mutual respect for each other as current or previous K-12 teachers, and genuine caring about each other as human beings, we now sought to develop specific interventions that would help participants address the barriers (including anxiety) that prevented them from engaging in mathematical lessons.

Contextualization of Mathematical Content

In order to engage participants in mathematics instruction, we found it necessary to contextualize our teaching in ways that both acknowledged the complexity of being an adult learner of content and was simultaneously useful to participants in their own practice. Because participants were diverting our mathematical discussions, we began focusing the initial coursework on lesson design, using mathematical concepts only as a general point of reference. Transcript and journal data revealed that approaching the mathematical content indirectly in this way allowed participants to feel more comfortable, as they believed they had background knowledge to contribute (they had been designing lessons for years). For example, in an email sent after two weeks of this new approach, one participant thanked us for "an exciting class that was genuinely fun. It was nice to see how to approach finding domain and range. I'm going to try to explain it in this way after we go over my lesson idea next week." This representative quotation reveals that focusing on designing new lessons provided a non-threatening context and helped participants to see our time together as relevant to their immediate practice. We could then shift discussion to what is a mathematical concept, which then transitioned nicely to the elaborated exploration of the concept under consideration. Although participants ended up learning a new way to approach designing lessons that was more focused on content understanding, the context had a shared common ground that did not bring in issues related to fear of public recognition of lack of understanding, thus leaving their professional identity intact.

In implementing these content-focused discussions, we opted to select content that the participants placed as a priority, thus acknowledging their immediate concerns and external pressures. It was important to our professional relationship to embed all class meetings in participants' current practice in ways that *they* perceived to be useful. For example, we had anticipated beginning with conceptual work of functions but realized, based on participant feedback, that we must begin with set

theory and the Real Number System. As part of this process, we began by asking what the teachers understood about the mathematics before moving to less familiar content. Beginning with mathematical content about which the teachers felt more secure in their understanding allowed us to alleviate mathematical anxiety. This indirect approach established a foundation upon which we could develop mathematical discussions of more difficult, and perhaps new, content. We simultaneously required the teachers to explain their own content knowledge of relevant concepts within lesson planning assignments.

Finally, we explicitly communicated that the learning and teaching of mathematics are an ongoing, reflective practice. One way in which we scaffolded this perspective was to make revision an integral part of all assignments and lessons. We encouraged the teachers to send us electronic drafts of their work. We openly modeled revision and highlighted the importance of reflection in knowledge construction. Sometimes these processes also involved group assignments and lessons they could share and each use in her own classrooms.

Negotiation of Professional Identity

As we came to better understand these teachers' practice, we used their stories of success to develop discussions of how to use understandings of mathematics, teaching, and learning, to improve practice. This approach showed respect for what participants had accomplished within the building and with their students, while allowing them to expand their professional identities. Analysis of data showed that we first needed to build a relationship that would help us to assess the teachers and their needs. This relationship needed to encompass both the overwhelming complexity of the context and a shared trust based on recognition of our commitment to caring about the participants' students' lives and learning beyond achievement scores.

Communicating their circumstance to us provided the participants an opportunity to share and unite in their experiences, as well as brainstorm solutions. Having us present and involved during these communications afforded participants both objective, knowledgeable witnesses and mediators. On end-of-program surveys, participants articulated this aspect of the experience as being extremely helpful to their departmental relationships and position within the building. We used research articles to ground the discussions and support the important role that a teacher's content knowledge plays in pedagogical decisions.

Finally, building this relationship among teachers and professors also involved finding a shared trust. We are not saying that a friendship must develop to create a successful professional development community; rather, we intend the necessity for finding a shared understanding that establishes a common ground. Seemingly unrelated moments laid the foundation for a relationship that would allow for more substantive explorations of content and pedagogy. Work in the area of counseling supports this notion that establishing a trusting, empathetic relationship is an essential ingredient for such intensive, on-going efforts (House & Kahn, 1985).

Concluding Comments

This work supports the notion that teacher educators must understand more about teachers' needs, particularly in failing schools, before engaging in professional development. Perhaps due to the dire situation and urban location of The City School, this realization became abundantly clear. Many urban schools are wrought with mismanagement and performance issues. As the editors of *Education Week* (1998) note, "Somehow, simply being in an urban school seems to drag down performance" (p. 10). Within urban environments, Monroe and Obidah (2004) highlight the importance of cultural synchronization between the teacher and her/his students in predominately African American schools. This attention to culturally responsive education (Banks & Banks, 1995) has been shown to contribute to the students' academic success (Ladson-Billings, 1990).

Our research supports that culturally responsive education must also exist at the level of professional development. It has been our experience that this approach should be two-tiered: (1) teacher educators must be responsive to the fact that adult learners (teachers) feel purposeful in meeting the contextual needs of their students; and (2) teachers should consider the affective and contextual needs of their own students. Within this study, a parallel existed between teachers recognizing that they need to connect with their students *and* researchers needing to develop shared trust with adult learners before making progress on content. However, as our findings indicate, this attention to student contextual need, whether in a professional development or K-12 setting, must not overshadow the progress that needs to be made relative to content. Hence, what we present in this study provides insight into the important relationship between context and learning of content, and how to incorporate both into the design of professional development in urban schools. We suggest that further investigation systematically explore this two-tiered phenomenon.

Furthermore, teacher educators can better facilitate professional development by providing teachers a vehicle through which they can feel empowered and make change. Teachers want to feel as though their opinions are heard and valued. In a study of professional development with secondary mathematics teachers, also in an urban context, Lachance and Confrey (2003) provided such a vehicle for teachers by developing an interactive community that encouraged collegiality and sharing. They found that grounding discussions in mathematical activities allowed for the generation of community, which could then provide teachers with a foundation for instructional change.

While we agree that both components (content and community) are needed to facilitate change in practice, our work suggests that the establishment of a community based on a trusting relationship might be a necessary requirement to fully engage teachers in learning mathematics. As Lachance and Confrey (2003) note, "there is very little in the literature discussing the development or existence of teacher communities that addresses the notion of using mathematical content (or other subject content) as the "issue" around which teachers can interact and profes-

sional communities can develop," (p. 132). The experiences conveyed in this study will ideally move teacher educators forward in their thinking about development of teacher communities.

This study promotes the idea that teachers involved in professional development situations and/or research projects need to view the facilitators as human beings who care, as opposed to merely outsiders telling them what to do and how to behave. We believe that our teachers originally saw us as highly educated white women, who were likely passing judgment and there to tell them the *correct way*. Although many may find this observation obvious, we are conveying here that teachers' unspoken perceptions must be explicitly and overtly attended to in the planning and implementation of research and/or professional development efforts. While we were invited into this community, it was impossible to miss the fact that we did not look like others in the building and had agendas (e.g., research) other than improving The City School that simply made us different. In the future we will acknowledge race and other differences (e.g., level of education, teaching experience) upfront and therefore, hopefully, circumvent any possible negative effects that naively ignoring difference can bring. In this situation, fostering relationships before engagement would have alleviated much of the time spent on negotiating roles and finding our professional and personal "place" in the building.

What we found genuinely surprising was the level of anxiety the teachers had over their own insufficient knowledge of mathematics and how intricately it was bound with both their personal and professional identities. While these findings may be anticipated in an elementary context, it is not often discussed in high school situations and therefore must be further investigated. In future professional development situations we will not hold assumptions related to any teacher's content knowledge, beliefs about content knowledge, and how these aspects (in addition to context) define and shape the development of a teacher's view of good teaching.

To facilitate successful professional development that supports teachers' practices and content knowledge, this discussion highlights the important and complex role that context plays in this process, especially within urban environments. This work argues that teacher educators must first seek to understand teachers' stories before we can select both what is done within a professional development effort, as well as how it should be implemented. Facilitators of professional development must caution against making assumptions related to generalizability of prescribed practices across different fields; we must acknowledge and design within the situated nature of practice (Lather & Ellsworth, 1996). Furthermore, some research suggests that implementing appropriate activities in a long-term teacher development collective that is adequately funded and emphasizes content is sufficient to improve mathematics teacher education (e.g., Garet, et al., 2001).

However, based on our experiences working in this effort, we have found the interactions within a given structure to be just as important as the existence of the structures themselves. As a result, we urge others to consider and systematically

study the complex component that context, particularly the relationships embedded within a professional development community, plays in teacher learning and change in practice.

References

Alsup, J. (2006). *Teacher identity discourses: Negotiating personal and professional spaces*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ball, D. L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. *Journal of Teacher Education, 51*(3), 241-247.

Ball, D., Lubienski, S., & Mewborn, D. (2001). Mathematics. In V. Richardson (Ed.), *Handbook of research on teaching* (4th ed., pp. 433-456). Washington, DC: American Educational Research Association.

Banks, J. A., & Banks, C. A. M. (Eds.) (1995). *Handbook of research on multicultural education*. New York: Macmillan.

Borko, H., & Putnam, R. (1995). Expanding a teacher's knowledge base. In T. R. Gusky & M. Huberman (Eds.), *Professional development in education* (pp. 35-65). New York: Teachers College Press.

Borko, H., & Putnam, R. T. (1996). Learning to teach. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 673-708). New York: Simon & Schuster Macmillan.

Cohen, R., & Leung, P. (2004). Math-anxious, elementary teachers' change processes in a graduate course aimed at building math confidence and reducing anxiety. *Proceedings of the 26-th Annual Conference of the North American Chapter of the International Group for the Psychology of Mathematics Education, Toronto, Canada,* 1079-1086.

Darling-Hammond, L. (1997). School reform at the crossroads: Confronting the central issues of teaching. *Educational Policy, 11*(2), 151-166.

Darling-Hammond, L. (1999). *Teacher quality and student achievement: A review of state policy evidence*. Seattle, WA: University of Washington: Center of Teaching and Policy.

Darling-Hammond, L. (2000). Teacher quality and student achievement. *Educational Policy Analysis Archive, 8*(1), Retrieved October 2, 2005, from http://epaa.asu.edu/epaa/v8n1.

Education Week. (1998). *Quality counts '98: The urban challenge*. Bethesda, MD: Editorial Projects in Education.

Farmer, J. D., Gerretson, H., & Lassak, M. (2003). What teachers take from professional development: Cases and implications. *Journal of Mathematics Teacher Education, 6*(4), 331-360.

Frykholm, J. (2000). A missing piece in secondary mathematics teacher education. *Focus on Learning Problems in Mathematics*, *22*(1), 27-44.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research, 38*(4), 915-945.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education, 21,* 33-46.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(2), 371-406.

House, J. S., & Kahn, R. L. (1985). Measures and concepts in social support. In S. Cohen & S.

L. Syme (Eds.), *Social support and health* (pp. 83-108). New York: Academic Press.

Lachance, A., & Confrey, J. (2003). Interconnecting content and community: A qualitative study of secondary mathematics teachers. *Journal of Mathematics Teacher Education, 6*(2), 107-137.

Ladson-Billings, G. (1990). Like lightning in a bottle: Attempting to capture the pedagogical excellence of successful teachers of Black students. *International Journal of Qualitative Studies in Education, 3,* 335-344.

Lather, P., & Ellsworth, E. (1996). Situated pedagogies: Classroom practices in post modern times. *Theory into Practice, 35*(2), 71.

Little, J. W. (2002). Locating learning in teachers' communities of practice: Opening up problems of analysis in records of everyday work. *Teaching and Teacher Education, 18*(8), 917-946.

Loughran, J. J. (2004). Learning through self-study: The influence of purpose, participants and context. In J. J. Loughran, M. L. Hamilton, V. K. LaBoskey, & T. Russell (eds.), *International handbook of self-study of teaching and teacher education practices* (pp. 151-192). Dordrecht: Kluwer Academic.

Miller, E. (1998). The old model of staff development survives in a world where everything else has changed. In R. Tovey (ed.), *Professional development, Harvard education letter focus series* no. 4 (pp. 1-3). Cambridge, MA: Harvard Education Letter.

Monroe, C. R., & Obidah, J. E. (2004). The influence of cultural synchronization on a teacher's perceptions of disruption: A case study of an African American middle school classroom. *Journal of Teacher Education, 55*(3), 256-268.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Newmann, F., Secada, W., & Wehlage, G. (1995). *A guide to authentic instruction and assessment: Vision, standards and scoring*. Madison, WI: Wisconsin Center for Educational Research.

Palincsar, A., Magnusson, S., Marano, N., Ford, D., & Brown, N. (1998). Designing a community of practice: Principles and practices of the GIsML community. *Teaching and Teacher Education, 14*(1), 5-19.

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Rsearcher, 29*(1), 4-15.

Richardson, V., & Anders, P. L. (1994). The study of teacher change. In V. Richardson (Ed.). *Teacher change and the staff development process* (pp. 159-180). New York: Teachers College Press.

Sarason, S. (1996). *Revisiting the culture of school and the problem of change*. New York: Teachers College Press.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage Publications.

Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2000). *Implementing standards-based mathematics instruction: A casebook for professional development*. New York: Teachers College Press.

U. S. Congress. (2001). *No Child Left Behind Act of 2001*. Public Law 107-110. 107th Congress. Washington, DC: Government Printing Office.

United States Department of Education. (2000). *Before it's too late: A report from the national commission on mathematics and science teaching for the 21st century*. Jessup, MD: Education Publications Center.

U.S. Department of Education. (2003). *Secretary's Mathematics and Science Initiative: Teacher*

knowledge working group report. Washington, DC: U.S. Department of Education.

Walker, P. C., & Chappell, M. F. (1997). Reshaping perspectives on teaching mathematics in diverse urban schools. In J. Trentacosta (Ed.), *Multicultural and Gender Equity in the Mathematics Classroom: The Gift of Diversity* (1997 Yearbook), pp. 201-208. Reston, VA: National Council of Teachers of Mathematics.

Wilson, S., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. In A. Iran-Nejad & P. D. Pearson (Eds.), *Review of Research in Education* (24 ed., pp. 173-209). Washington, DC: American Educational Research Association.