Moving beyond the Barriers:
A Re-defined, Multi-leveled Partnership Approach to Mathematics Teacher Education

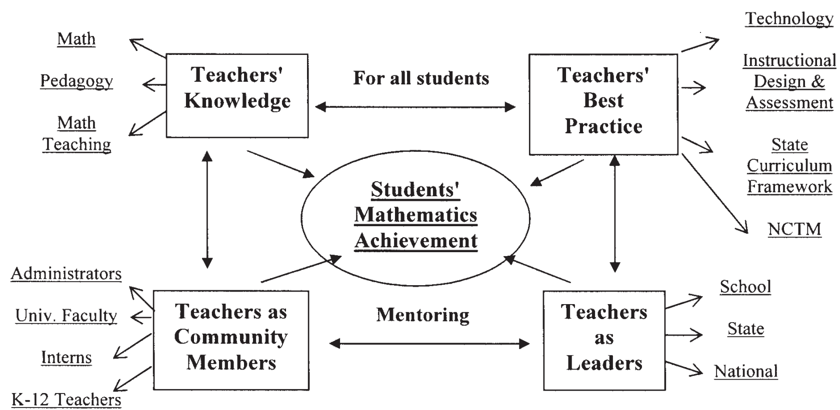
Babette M. Benken
California State University, Long Beach
& Nancy Brown
Oakland University

The combination of federal exigency for Highly Qualified Teachers in every classroom (No Child Left Behind, 2001) and focus on teacher accountability has created a plethora of routes to teacher certification and continuing education. This urgent situation has placed a burden on schools of education to approach teacher education in creative and expedited ways, while concurrently placing focus on content knowledge and research-based pedagogy. In response we (university faculty in teacher education and mathematics) designed a mathematics community continuum (MCC) that expands and redefines the traditional relationship among schools of education, colleges of arts and sciences, and school districts. Within this community continuum we used mathematics as a content vehicle and an urban mini-district as a ripe context to study teacher learning and development. The MCC (Figure 1) builds a reciprocal community using multi-level mentoring, site-based professional development, shared expertise, and research to facilitate teacher growth and learning of prospective and practicing teachers, school administrators, and university faculty.

Our goal with this project was to understand ways to envision and implement alternative structures for mathematics teacher education,

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

Figure 1
Mathematics Community Continuum



as well as teacher education more generally, which addressed federal demands and provided a model for exemplary design of university-school partnerships. 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, 1995).

For this project there were many lines of parallel inquiry; in this paper we discuss findings relative to the following question: *In what ways did the structure of the continuum help to advance the learning of mathematics and its teaching?* Throughout the rest of this paper we outline the details of this community continuum, particularly as it pertains to mathematics teacher education and professional development. As part of this description we provide a synthesis of relevant literature that framed the development of this continuum, as well as why this context provides a rich window for studying professional development, particularly in the area of mathematics. Finally, we outline how the findings of this research study inform understanding of alternative structures of mathematics teacher education at all stages of development.

Review of Literature

Relevant research in the areas of mathematics teaching and learning, teacher development and change, and effectiveness within urban schools provided a framework for this professional development project and research study. Effective professional development can be an invaluable foundation for high-quality, reform-oriented teaching, which can then lead to student learning (e.g., Killion, 2002; U. S. Dept. of Education, 2000). Furthermore, teachers serve as the primary catalyst for change in students' learning (Borko & Putnam, 1995). The community continuum goals were thus focused on teacher development at all levels and included: increasing teacher knowledge, supporting and mentoring teachers in efforts to align practice in ways that improved students' mathematical understandings and ultimately students' achievement, and building a school community that nurtured teacher leadership and collaborations with prospective and practicing teachers, teacher leaders, administrations, university faculty and the mathematics educational community.

The U. S. Department of Education (2000) identifies a teacher's content area knowledge as the most important qualification. National (e.g., NCTM, 2000) and state-level recommendations call for an approach to mathematics teaching that allows students to communicate, problem-solve, and engage in conceptual mathematics. 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.

Another major area of educational research on which this project drew related to the *design* of professional development. Much research currently exists that explores alternative designs of professional development that utilize frameworks involving school-university partnerships through the creation of such entities as *professional development schools* (e.g., Castle, Fox, & Souder, 2006; Darling-Hammond, 1994), or more recently *communities of practice* (e.g., Palincsar, Magnusson, Marano, Ford, & Brown, 1998). Although this work has contributed to what is understood about how teachers can learn from on-site mentoring, this work does not fully capitalize on the opportunity to incorporate all levels of learner (e.g., practicing teachers, administrators) within a design of professional development. Additionally, this body of work has not provided clear pathways for how to design collaborative efforts between departments of mathematics and schools of education that place as focus content understandings of teachers embedded in teachers' own practice, nor has it explored how to facilitate mutual learning and growth among all constituents, including university faculty from arts and sciences and education.

Our continuum extends this literature by using a multi-leveled approach to teacher education. This approach is framed by the *legitimate peripheral participation* of learners (Lave & Wenger, 1991) at all stages of professional development. Within this model (Figure 1), multiple constituents (arts and sciences faculty, education faculty, administrators, prospective teachers or *interns*, practicing teachers) participate in the activities and generation of the mathematics learning community; mentoring, knowledge and pedagogy are all central and interconnected. A unique aspect of this continuum is the incorporation of all levels of learner, which provides a lens through which to understand learning throughout the entire span of teacher development. Simultaneously, this community serves as an alternative, context-specific vehicle through which administrators and practicing teachers can become Highly Qualified through on-site professional development. Furthermore, while university mathematics faculty are typically integral to initial teacher certification by providing coursework at the pre-service level, rarely are they involved with in-service teachers or school-based programs. Our continuum affords a unique opportunity for mathematics faculty to experience adaptation and application of this content instruction in classrooms and experience community dialogue that integrates pedagogy, content, and pedagogical content knowledge.

Using a multi-layered mathematics community continuum further expands existing literature by affording a context within which the development and enactment of new public images of best practice are co-constructed by all constituents. Within research on professional development there is often an unaddressed assumption that there is a shared understanding and valuing of the public notion of best practice. This assumption has inhibited the possibilities of successful professional development collaborations, as it arbitrarily places boundaries on the function each member can play within the community (e.g., Darling-Hammond, 1994). This continuum explicitly addressed and explored the possibly different visions that partnership members bring to the table related to both content and pedagogy. For example, mathematics faculty often have views of how to approach central mathematical concepts that differ from education faculty's and elementary teachers' vision of how to embed the mathematical content in professional development. Additionally, this community recognized and investigated issues of power among constituents; power struggles have been shown to impede communication within and effectiveness of professional development efforts (Bier, Kazemi, Horn, Stevens, & Peck, 2007).

Scientifically-based 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 study of curriculum, assessment, and instruction (Newmann, Secada, & Wehlage, 1995), (4) modeling of practices that promote effective student learning, (5) opportunities to negotiate learning within the context of the teachers' own practice and classroom (Wilson & Berne, 1999), and (6) differentiated learning experiences that meet the specific needs of the teachers, e.g., grade level, background content knowledge (Benken, Brown, & Smith, 2007). Within professional development for elementary teachers, we must therefore include challenging mathematical learning experiences complete with opportunities for teachers to reflect on practice within the context of their teaching (Garet, Porter, Desimone, Birman, & Yoon, 2001). Our project incorporated all six of these suggested research-based elements, with all components of the project being implemented at the teachers' school. Additionally, our project utilized an enlarged community with constituents representing many educational roles, thus extending the vision of community and mentoring in the existing literature.

Furthermore, in order to help teachers make changes in their teaching practice that are effective and transformative in nature we cannot rely on traditional professional development formats. Isolated and short-term staff development has proven inadequate for effective school reform and improved student achievement (e.g., Darling-Hammond, 1997, 1999). Teachers often report these one-shot workshops to be irrelevant and they forget most (~90%) of what they perceive they have learned (Miller, 1998). This approach does not allow teachers to address misconceptions, construct new orientations, and learn to teach for understanding. Hence, to facilitate growth in teachers' knowledge and beliefs, our professional development intervention was long-term and incorporated the teachers' mathematics understandings through practice-based discussions.

Finally, designing professional development becomes increasingly complex when layered with issues specific to urban 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). The components of our professional development project thus placed a critical focus on the interplay between the mathematical concepts taught and the views of mathematics embedded within each individual teacher's practice as they existed within this under-performing, urban, charter school setting. Each component was therefore situated within the participating teachers' practice, making use of *their* standards-based instructional materials, student work samples, and an exciting lesson planning protocol to support teachers as they developed both the knowledge and disposition needed to teach mathematics in effective ways.

Details of the Mathematics Community Continuum

Our community continuum was a long-term, on-site professional development project that existed among a school of education, a mathematics department, and a high need, urban mini-district (charter school). The members of this community were drawn from five primary groups: prospective elementary education teachers (*interns*), practicing elementary teachers, practicing high school teachers (*teacher leaders*), school administrators, and university faculty/researchers (Figure 1). Based on the current research recommendations outlined in the previous section, we (researchers/instructors) created this effort in response to this school's history of low student achievement and our Nation's promise of a Highly Qualified teacher in every classroom, particularly in mathematics.

This school provided a unique and rich context for this project for the following primary reasons: a large percentage of under-qualified teachers, flexibility to create and implement curriculum innovation, and an urban setting to explore the design and implementation of mathematics professional development. Additionally, having worked with teachers in this charter school's secondary location, we had a working relationship with staff and administrators, and were invited into the community to develop and facilitate professional development at the elementary level (Benken, Brown, & Smith, 2007). Previously developed trust with this charter school system helped to facilitate generation and commencement of the community, as all members were comfortable with our presence in both the building and their classrooms, thereby circumventing issues of power that often prevent professional development initiatives from achieving maximum success (e.g., Bier, Kazemi, Horn, Stevens, & Peck, 2007). Finally, administration at this site found the multi-level mentoring, which included prospective teachers, to be an exciting context for meeting the daily classroom needs and long-term professional growth of their teachers.

Key components of this professional development experience included:

- Collaboration among all constituents surrounding a focus on students' improved conceptually based understandings and achievement, as well as increased performance on high-stakes state assessments;

- Attention to on-going intellectual and emotional support of the community through conversations surrounding practical needs of practice, generation of a trusting working relationship, and new learning that was occurring during sessions and classroom activities;

- Bi-monthly professional development sessions that worked with teachers on their understanding of general pedagogy, mathematical content (and other subject-matter content) and pedagogical content knowledge, and how to implement reform curricula in their classrooms; these sessions were held during the teachers' site-established professional meeting time;

- An approach to professional development instruction that allowed teachers to work on their specific classroom needs; in this way session instruction was differentiated to meet the needs of the individual learners (i.e., teachers);

- Mentoring partnerships that involved interns and practicing teachers working together in the same classroom;

- Summer workshops that focused on the interaction among constituents to facilitate school's articulated goals; and

- On-going, guided reflection with teachers, teacher leaders, interns, and building administrators through journals (prompt-based and open-ended) and email correspondence.

Methodology

Context and Participants

This long-term (2 years), on-site professional development project existed between a large, public university (~16,000 students at the time of this study) and a high need, urban charter school, School C. Charter schools are publicly funded elementary or secondary schools that have been freed from some of the rules, regulations, and statutes that apply to other public schools in exchange for some type of accountability for producing certain results, which are set forth in each school's charter

(National Education Association, n.d.). However, charter schools are required to uphold the same state- and federal-level fiscal, regulatory and academic standards as other public schools. School C (grades K-5) is located in a large, metropolitan city, and at the time of this study had 1,050 students. All of the student body was minority (100% African American) and most (61%) were considered underprivileged according to state records (www. http://www.michigan.gov/mde). School C articulated a focus on increasing student achievement and preparing students for post-secondary educational and/or workforce experiences. To support this dedication to academic preparation of students, administration kept the student-to-teacher ratio to 22:1. Our initial conversations indicated that faculty and administration were concerned about their students' learning and interested in on-going professional development with our then common university.

In spite of this school's commitment to its students, our (school administration and university faculty) shared perception was that School C needed to make changes in its academic programs. Since the school opened in 1998, it had suffered from consistently low, high stakes state test scores in all disciplines, especially mathematics. For example, only half of the fourth grade students were able to pass the mathematics portion of the state exam in 2004, which was lower than the statewide passing average—73%. This school had high teacher turnover (40%), and all of the teachers only held provisional state certification. It was due to School C's circumstance that the administration and faculty were eagerly responsive to on-going professional development that focused on faculty knowledge leading to student achievement at their school. Administration encouraged attendance at the professional development sessions by allowing us to schedule them during the teachers' regular, school day release time and making the hosting of an intern contingent upon involvement.

For the purpose of the research question explored in this paper (*In what ways did the structure of the continuum help to advance the learning of mathematics and its teaching?*) participants included three of the five constituent groups: 20 practicing elementary teachers (K-3) at School C, 6 school administrators at School C, and 2 university faculty/researchers. Participation in the parallel research study (i.e., consenting to being part of the data set) was strictly voluntary, and was supported by a small stipend from a university-supported, internal grant.

Data Sources

Data were collected throughout the 2005-2007 school years (August to June). Primary data sources related to the findings in this paper included: (1) transcripts of audio taped interviews (30-45 minutes) with a subset of participants (teachers and administrators, selected based on participants' availability of schedule and time) at the beginning, middle and end of each year of the professional development experience, (2) two sets of researcher field notes of community meetings (classes), (3) participant (teachers and researchers) reflection journals, (4) teacher beliefs and knowledge surveys administered at the beginning and end of the professional development experience (pre-post), and (5) selected artifacts from teachers (e.g., classroom assignments) and School C.

Analysis Approach (Three Phases)

Analysis occurred in three phases. First, data were analyzed using *direct interpretation* (Stake, 1995) to garner overall emergent themes (based on pre-post comparisons, frequency made in statements, and level of importance to participants) to understand the substantive growth in participants' knowledge, views, and practice, and the role that the structure was playing in that development. Codes were determined by a thorough analysis of course artifacts, surveys and participant dialogue, as well as participant reflections in journals. Codes are included in Table 1.

Second, data were *aggregated* (Stake, 1995) within constituency groups to identify trends within each group (e.g., teachers), and establish patterns that would allow for an understanding of the impact of structure. Finally, we did an analysis across constituents to determine in what ways the structure of the continuum helped to advance the learning of mathematics and its teaching, as well as the possible impact on long-term growth and quality of evidence of value-added role in student learning.

Validity issues were addressed by triangulating data, coding independently by two researchers (allowing for cross-validation of results), and externally validating coding by the long-term nature of the project. Reliability was enhanced by researchers keeping separate journals throughout the project and its planning, in which they recorded personal reactions to the experiences, emergent ideas, possible related literature, ethical considerations and dilemmas, and general perceptions of participants and the impact of program. These journals also served as an additional source of data, the comparison of which helped triangulate and validate findings.

Results

In this section we organize results around areas of learning that occurred for participants. These types of learning include: learning of mathematics, learning of mathematics teaching, learning of general pedagogy, and learning of collaborative practices. Following this discussion,

Table 1. Analysis Coding Scheme.

Code Category	Code Sub-category	Example
Mathematics	• Attitudes	• "Whenever I teach math I flash back to feeling sick in math classes."
	• Conceptual understanding/skills	• "Students do not see that our system is based on ten, even though I tell them and show them the place value columns. It's all in the columns."
Mathematics Teaching	• Attitudes	• "I find math more difficult to teach than my other subjects, because I can't make it fun."
	• Aspects of practice	• "When I don't know what to do, I just use worksheets from the text."
Mathematics Learning	• Understanding/ awareness of own learning	• "It was so interesting to hear my teachers share their math concepts I'd never really thought that carefully about math before."
	• Understanding/ awareness of students' learning	• "I think some students can't get math, and for some it's just easy."
General Pedagogy (instructional design and assessment)	• Understanding/ awareness	• "The textbook shows me how to plan; I just need to follow the directions."
	• Developmental knowledge of students	• "Not all students are ready at the same time."
Collaborative practices across constituent types	• Attitudes	• "I love having the curriculum director here because now he sees how hard it is for us."
	• Ability to learn from others	• "It was fun seeing the interns' ideas for field trips, as they found fresh ideas I hadn't thought of."

we extrapolate how the structural components synergized to facilitate each area.

Learning of Mathematics

The group that learned the most related to mathematics was the practicing elementary teachers (K-3). Initially, they had to confront their fears related to learning mathematics. Early in the professional development sessions, mathematics anxiety emerged as an important concept, as it inhibited participants' learning. For example, they communicated that they had been avoiding planning mathematics lessons and approached those they did implement superficially. As two first grade teachers admittedly exclaimed during one session in October (Year 1), "We usually toss a coin to see who has to take math for the week; sometimes we never get to it." Other participants found their confession humorous and familiar. Math anxiety is more than a dislike towards mathematics; it is a feeling of intense frustration about one's ability to comprehend and apply mathematics. Tobias (1993) and Smith (1997) found that those who suffer from math anxiety possess a number of symptoms that include but are not limited to: uneasiness or inability to perform mathematically, avoidance until the last possible moment, and feelings of physical illness, faintness, dread, or panic. Our findings support other research, which reveals that math anxiety exists among pre-service and in-service teachers, particularly at the elementary level, and influences practice (e.g., Cohen & Leung, 2004; Hembree, 1990).

Throughout this effort participants came to learn that math anxieties needed to be addressed to become successful mathematics teachers. Early in the school year we focused on the participants adopting strategies (e.g., collaboratively working on mathematics lessons, keeping the discussion focused on mathematics needed for effective teaching as opposed to mathematical deficiencies) to overcome their anxieties (Smith, 1997). By the end of the first year participants' statements made in both sessions and on reflection assignments revealed they were cognizant of the spiraling effect their mathematics anxiety was having on their practice. As one participant stated, "I guess I never thought about the consequences of my spending more time on other subjects. I guess I was just hoping that [students] would catch up in the higher grades." Specifically, their avoidance of mathematics teaching was the central reason why they had not been learning new approaches to mathematical concepts, and perhaps also why their students had not been successful on standardized assessments.

Another important learning that occurred for both the practicing teachers and administrators was that the K-3 mathematics concepts were not as straightforward as they had originally conceptualized. Specifically, early mathematics is conceptually compact, and not merely a list of procedures and terms. As one administrator (building principal) noted during an end of year interview (May, Year 1), "No wonder we were doing so poorly on our exams. I had always thought of mathematics as the essential *how to's*, how to add, how to count, … Although I had approved the Curriculum Director's request for a new mathematics curriculum, I really did not understand the problem with the old text." Within sessions we focused on lessons with which the teachers were struggling (e.g., Base Ten System, fractions), and through a process of pulling apart important concepts (e.g., what it means for a system to be based on ten) the teachers indirectly learned mathematics to a greater depth and simultaneously became more confident about approaching the design of mathematical lessons.

Learning of Mathematics Teaching

As noted above, once the teachers began to learn more mathematics, they believed that they could be creative with their teaching. Additionally, they perceived that they needed a deeper understanding of mathematics in order to improve their ability to plan for and enact instruction. For example, at the beginning of our sessions participants did not perceive mathematics to be a fluid, connected subject, as they did reading. Through collaborative examination of content embedded within the teachers' existing lessons, we modeled the process of placing conceptual development as central to both planning and teaching. For example, during one session we asked participants what they would want their students to learn in a given lesson that one teacher shared on place value. Most participants had no immediate response, and the two who did respond, did so in relation to memorized skill-focused outcomes (e.g., "I want them to know the columns."). Toward the end of this session, one participant exclaimed, "Oh, so our system is based on grouping by ten, and that's why you multiply by ten to go from the ones place to the tens place." Participants' growth in content understanding allowed us to then move to a discussion of how best to teach this content and position it within their K-3 curriculum.

Throughout this collaborative learning process both teachers and administrators conceptualized the idea of *pedagogical content knowledge*, and simultaneously began to communicate that teaching mathematics was more difficult than they had imagined. They discussed instruction in terms of more than applying provided worksheets and activities. However, during our first year of the project the teachers were also struggling with attempting to learn and implement a new, more reform-based mathematics curriculum. They perceived this task to be "daunting," perhaps even more so once they communicated (and perhaps therefore synthesized) that good instruction involves much reflection and thought. What both us and the administrators learned was that given where these teachers were with their understanding of both mathematics and its teaching, both on-going and intensive support within their classrooms would also be necessary to begin to enact the new curriculum.

Learning of General Pedagogy

Both teachers and administrators gained an understanding of what it means to design instruction versus using a provided lesson plan; and expressed that they understood that this idea extends to more than just one subject. For example, we facilitated lessons on a new approach to instructional design and assessment, including curriculum mapping (i.e., how to use content as a vehicle to design lessons). Both teachers and administrators welcomed general discussion on pedagogy, so that they could make connections between approaches that they used to teach more comfortable subjects (e.g., reading) and the teaching of mathematics. As one teacher explained in a small group after examining another teacher's lesson plan on *neighborhood and city*, "What do you want your students to understand?" This question illustrates her thinking about lesson design as more than a matter of activity; rather, the emphasis in planning should be on students' understanding. The teachers began to understand the difference between methods and activities, suggesting a transition to pedagogical content knowledge.

Throughout these sessions we emphasized that part of teaching involves learning how to use resources effectively; a teacher should not have to reinvent the wheel. With enough time and understanding of content, teaching can be a fun and creative endeavor, without sacrificing attention to content. One essential movement in participants' learning was how to utilize resources in the new curriculum efficiently, imaginatively, and in ways that aligned with the state's outcome expectations.

Learning of Collaborative Practices

Related to their learning of designing instruction was the teachers' recognition of the collaborative intent of scope and sequence. In having teachers collaboratively envision the *big picture* of aligning curriculum across the entire school year, teachers became conscious of the yearly curriculum for all grades represented (K-3), thereby understanding the vertical impact of their pedagogical choices. Now teachers saw that not addressing mathematics in their classes would have dire consequences for students' preparedness for future grades. Concurrently, the teachers of higher grades were exposed to content in earlier grades, and saw the importance of aligning both vocabulary used and approach embedded in each essential concept; in essence, they learned the importance of a collaboratively generated common language and goal structure.

As part of developing scope and sequence, both teachers and administrators learned that in addition to their own practice and duty, each community member needed to incorporate school-wide goals for student learning and assessment. For example, the Director of Curriculum commented at the end of Year 1 that he appreciated our group conversations related to which state-level standards were being used to define mathematics curriculum design in the building. He had told his teachers to use a set of standards that were now out of date, and therefore they had not been meeting his intended goals. We helped facilitate both continuum constituents' learning of the current standards and how to negotiate those standards with already established school targets for statewide assessment scores.

Related to this aspect of learning was the acknowledgement by all participants (teachers, administrators, faculty) that each member of the community played a particular role in making change and facilitating daily activities. Equally important, however, they learned that each constituent in an educational setting must recognize that his/her role should remain flexible, as each community member can be a leader, learner, and instructor.

For example, in one session teachers wanted to share their reaction to budget cuts and the subsequent negative impact they perceived it having at the classroom level (e.g., lay-offs, lack of supplies). At that moment we chose to expand our professional development facilitators' role to help with the process of debriefing and providing a context for strategizing how to cope with the ensuing changes. We learned that in this situation we needed to let the conversation go beyond usual boundaries of pre-determined professional development topics and maximize the opportunity for building community cohesiveness and accountability. We consciously chose to allow for their frustrations to become the center for learning about how to cope with building decisions in daily practice. One administrative participant (the building principal) simultaneously made a decision about her role in that moment of the professional development effort. She chose to sacrifice her learning and participatory role for her administrative one by leaving the room once it became apparent that the conversation would turn to teachers' frustrations. She did not want a leadership presence to prevent the continued discussion, and we (both teachers and university faculty/researchers) interpreted this gesture as indicative of her trust in our ability to facilitate it. Her leaving confirmed for us that all roles were necessary, yet the generated community allowed them to be flexible in implementation.

As shown in numerous examples, we had many sessions that were attended by both teachers and administrators. Both sets of participants communicated in both interviews and on surveys that learning can and should involve the entire community as a collaborative undertaking. For example, the teachers learned how to have conversations about their individual practice with their supervising administrators and us present. Furthermore, they learned how to both learn from and value the expertise of these individuals in a genuine way that permeated to daily decision-making. During these same sessions administrators learned to value their teachers' struggles and opinions in helping them negotiate school-level determinations. In this way, all participants adopted strategies for effective mentoring and how to learn within a multi-layered community.

Structural Components

In the previous sections we explicated the various types of learning that occurred with all groups of participants, bringing us to our research question, "In what ways did the structure of the continuum help to advance the learning of mathematics and its teaching?" Results suggest that the structure of our community afforded learning to all participants (*teachers*, *administrators*, *university faculty*) in multiple, interconnected ways.

Below we identify and elaborate those aspects of structure that were most salient in advancing the learning of the community members. These aspects included: the long-term, on-site structure of meetings that were held on a regular basis; the multi-layered nature of the community; the location of the effort in a high need school; the existence of a working, trusting relationship among constituents; and, the design of discussion that was facilitated in all meetings. Although each of these identified aspects was an independent component of the design of the professional development effort, they worked symbiotically to support learning within the community. For example, the existence of multiple constituents within a trusting, long-term community provided a context for communication building and learning related to collaborative practices.

Additionally, the nature of discussion coupled with the existing relationship helped in advancing learning related to mathematics and mathematics teaching. Our collaborative session discussions, which were based on mentoring and attention to teachers' practice, provided a context to alleviate anxiety that facilitated mathematical understandings for teachers, as well as involvement in lesson design. In particular, after recognizing the K-3 teachers' level of math anxiety, we began our first year centering discussions on the lessons generated by the interns (pre-service teachers), who were observing in the teachers' classrooms. This shifted the focus from K-3 teachers' pedagogical choices, thus helping to create a safe environment that would facilitate both their mentoring ability and learning to become content oriented teachers. In this way, mentoring was operating on many, interconnected levels: facilitators mentoring K-3 teachers, K-3 teachers mentoring interns, and all constituents ultimately mentoring students.

Perhaps the most salient factor of the professional development structure was the unique blending of multiple constituents within and throughout the community continuum. The multi-layered nature allowed for emergent learning opportunities, as noted in our previous discussion of constituents' roles. Specifically, this structure provided context for the generation of *internal accountability* (Hill, Lake, & Celio, 2002); i.e., through our collaborative work we were able to assist in building and maintaining the shared vision and expectations inherent in this building (School C). A school's internal accountability is often derailed through the everyday, pragmatic business of running a school, and the reality that many enter a community at various times and with sometimes conflicting visions.

Finally, the high need nature of School C brought people to the table with enhanced motivation and sincere interest in growth. Although one of the challenging aspects of professional development efforts can be finding incentive for participants to truly engage (Fishman, Marx, Best, & Tal, 2003), we did not face this potential limitation. This situation, coupled with an already existing relationship based on respect and trust, provided a ripe context for collaboration and faculty research.

Discussion

All of the structural components of our community worked together to support learning. These areas of learning, which encompass pedagogical, content, pedagogical content, and communicative learning, have all been shown to be essential in teacher education (e.g., Shulman, 1987). Specifically, for the teachers and administrators in our project the learning of mathematics, and subsequently how to effectively teach mathematics, was critical to participants' moving forward in the professional development effort. For example, once the teachers began to learn more mathematics and address their related anxieties, they recognized that they could be creative with their teaching. Additionally, both teachers and administrators saw that they needed a deeper understanding of mathematics content in order to improve their ability to develop and enact instruction, even if their focus was on the lower elementary grades.

Many structural components were central to facilitating learning within our professional development effort. What we found to be particularly interesting was how all the elements seemed to work together to assist learning in ways that we believe could not have been achieved in isolation. In particular, our multi-layered, interconnected community addressed a wide range of professional development needs in a way that was responsive to the specific set of issues and concerns in this context (School C). As most research echoes, teaching in urban settings is very difficult; most districts have high teacher turnover, low standardized test scores, and little continuity between administrators and faculty regarding school mission and method to achieving improvement (e.g., Anderson & Olson, 2006). School C was no exception. Although genuinely open to participating in our professional development community, both administrators and teachers understood their challenging situation regarding student achievement and teacher turnover, yet they did not have an existing vehicle to address these concerns, particularly related to mathematics. Our mathematics community continuum provided a needed pathway through which School C could begin to address its situation. In this way, our community contributes to existing literature; while much research contains lists of needed components for professional development, there is a need for clear road maps that illustrate how to successfully implement suggestions within specific settings (Darling-Hammond, 2006).

The setting chosen for this professional development study was a K-5 site of a K-12 charter school. We specifically selected this context for three primary reasons: (1) an existing, trusting, working relationship, diminished issues of power that often exist between schools and universities (Bier et al., 2007; Dixson & Dingus, 2007); (2) the local autonomy existing in a charter school setting afforded flexibility in administrative decision-making, including ability to make change and set schedule (Benken & Brown, 2007); and (3) the pre-existing, uniform belief in the school's mission of student learning generated a culture conducive to having outsiders present for research focused on the same goal (Hill, Lake, & Celio, 2002). In fact, our choice of setting more than met our expectations, as findings perhaps already communicate. Although we were cognizant of the fact that choosing such a unique context can, and usually does, limit the generalizability of findings, some unforeseen limitations also existed. For example, the essential limitation was that our philosophy of how to best educate students was not always in complete alignment with the communicated intentions of the local community. These theoretical differences required on-going communication and negotiation within our constructed community. Although our intent was always to address local need, our decision to conform was, at times, professionally challenging. For example, we respected, but did not completely agree with, the decision of the administration to supplement the new mathematics curriculum toward the end of the professional development program.

Within our community structure, the multiple layers of constituents, coupled with the nature of the facilitated discussion, became particularly salient features in generating growth and success toward goals of both School C and the community. Specifically, these structural components helped the community move toward an *integrated culture*, which nurtured both the intellectual and emotional needs of all members (Liston, Whitcomb, & Borko, 2006). As a result of constructing this culture, we unintentionally bridged the learning gap between pre-service and induction levels of professional development, thereby motivating and helping School C to retain promising and dedicated new teachers. Furthermore, this community culture provided a contemplative space where teachers, administrators, and university representatives could work to bolster School C's internal consistency toward vision and goals. More work is needed that defines frameworks for helping to promote the social and emotional development of teachers, as well as how to structure professional development that facilitates collaboration and collegiality at the level of school site (e.g., Liston, Whitcomb, & Borko, 2006).

This project provides a research-based model of how to structure teacher education in ways that improve teacher quality, as well as allow school faculty and administrators to become Highly Qualified. This model serves as an exemplar of how to design university-school partnerships that move traditional programs beyond the limiting barriers of exiting roles and isolated efforts. Findings contribute to what is known about professional development throughout the stages of teacher learning, as well as how professional development can be structured to address the critical need within urban schools. Ultimately, the effectiveness of any model of professional development is dependent upon the relationship it can bridge to student learning and achievement. The unique, on-site mentoring central to our community continuum model establishes a learning synergy within a supportive community that can allow for the desired link between professional growth and student achievement. We hope that our effort motivates more work in this needed area.

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