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Voices From The Field: Linking Theory With Practice In Mathematics Education

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ABSTRACT

The purpose of this study was to examine how teaching an on-site mathematics course with teachers and interns learning together could enhance a teacher preparation program. Teacher preparation programs are challenged to prepare elementary mathematics teachers to meet the visions of mathematics reform. Yet there exists a misalignment between what is taught in universities and what is practiced in schools. In response to this dilemma, the researchers designed a pilot study where a course was taught on-site. The cooperating teachers attended the class and participated in lesson study with their interns. In this article, the researchers describe the study and its influence on the three parties: interns, cooperating teachers, and professors. They also offer recommendations for linking theory and practice.

Introduction

Two university professors concerned with more effectively providing mathematics education in a teacher education program designed, implemented and examined an on-site mathematics course taught with cooperating teachers, interns and professors learning together. The findings and recommendations are relevant to teacher educators at a time when teacher preparation programs have been criticized for not adequately preparing teachers (Goodlad, 1997; Holmes Group, 1995; Darling-Hammond, 1997). Feiman-Nemser (2001) found that teacher preparation programs are not furnishing teachers with the knowledge, skills, and

support necessary to succeed. Several researchers/educators have tried to remedy the problem by examining teacher preparation and professional development experiences. Reports have advocated for more realistic training for teachers and have also recognized the importance of field experience in teacher education programs. (*What Matters Most: Teaching for America's Future, 1996, Doing What Matters Most: Investing in Tomorrow's Teachers, 1997)*

In the field, cooperating teachers are often grossly underused. The cooperating teacher is arguably the most important influence on new teachers staying in the field of education (Barker & Burnet, 1994). In their review of literature, Conner and Killmer (1995) found that the success or failure of a student teacher can be traced to the "influence of the cooperating teacher" (p. 11). Such findings, as well as their own experiences, have led these two professors to design and study an on-site methods course with cooperating teachers and interns learning together. The professors searched for better ways to prepare the next generation of teachers and to answer the questions: 1) How can university personnel design teacher preparation programs that are more successful in meeting the needs of today's teachers? 2) How can university personnel bridge the gap between the university and pre-kindergarten to grade PK-12 schools (bridge theory to practice) to meet the needs of the in-service (cooperating teachers) and pre-service teachers (interns)?

To study these questions the researchers designed a pilot mathematics methods course to be taught on site at the Professional development School (PDS). The course was designed to address the National Council of Teachers of Mathematics (NCTM) principles and standards and included cooperating and interns learning together with the expectation that transfer of knowledge and practice would be effectively assimilated. The recommendations found in the *Principles and Standards for School Mathematics*, "are grounded in the belief that all students should learn important mathematical concepts and processes with understanding" (p. ix). The purpose of this study is to examine how participation in this experience influenced the interns, cooperating teachers and university professors.

Theoretical Framework

The field of mathematics education has progressed exponentially in developing theories and research-based evidence about how to teach elementary school mathematics. Most of this research has been conducted using research projects that engage teachers in learning to teach mathematics. The findings from this research concerning math reform are complex and they require examination of the research from multiple perspectives. The body of literature that informed the pilot project design and shaped the present study focused on three strands of theory connected to teacher preparation: a) examine teacher preparation in general; b) address the reform of mathematics instruction; and c) look at the impact of collaboration, inquiry, and professional development.

Teacher Preparation Research

Drawing from the literature as well as her own research and experiences, Feiman-Nemser (2001) proposed a framework for thinking about a curriculum for teacher learning over time. She concluded that learning to teach, especially the kind of teaching recommended by reformers, requires coherent and connected learning opportunities that link the university classroom to new teacher induction and to continuing professional development for all teachers. She found that, "the experiences are often limited, disconnected from university coursework and inconsistent" (p.17). In their seminal work on mathematics teaching, Lampert and Ball (1999) suggested that, "Student teachers are often in the end most influenced by what they see their cooperating teachers do or by their own memories from school. The effect of teacher education is often small. Although they collect ideas, learn theories, and develop some strategies, beginning teachers often report that their professional preparation was of little use or practicality" (p.39). Mueller et. al (2003) recommended that "teacher education institutions and schools need to work collaboratively to generate a community of reflective practitioners who critique teaching methods and actively work to improve learning environments" (p. 439).

A commonly held belief among instructors and learners both at the university and in the schools is that knowledge is acquired in course work and applied in practice. Lampert and Ball (1999) suggested that this divide between theory and practice has left a critical gap unattended. These authors asserted that a second gap in teacher education lies between reform visions of teaching and the traditional pedagogy of teacher education. In explaining this gap they proposed that teachers are taught about constructivist theories of learning but constructivist methodology is not modeled by the instructor. "With little or no firsthand experience with learning of the kind that reformers advocate, neither beginning nor experienced teachers have adequate images of what these ideas mean, what it might mean to draw on them in practice, and the complications they raise for teaching and learning" (Lampert & Ball, 1999, p.39).

Learning to teach involves spending time in schools observing and interacting with teachers and students. Wilson, Floden and Ferrini-Mundy (2002) summarized the existing research on teacher preparation and found that " study after study shows that experienced and newly certified teachers alike see clinical experiences as a powerful- sometimes the single most important- component of teacher preparation. Whether the power of field experiences enhances the quality of teacher preparation, however, may depend on the particular experience" (p. 195).

Teaching Mathematics

After extensive research on the preparation of teachers of mathematics, the Mathematical Association of America (MAA) recommended that standards be designed so that future teachers of mathematics are able to communicate mathematically, comprehend the importance of mathematical modeling and relationships, use and appreciate technology, and value the historical and cultural context of mathematics. According to the MAA, these recommendations should be

a part of mathematics courses taken by both pre-service and in-service teachers and these courses should stress the vision of mathematics as a system of unified themes.

Out of the MAA research the National Council of Teachers of Mathematics (NCTM) provided recommendations for the teaching of mathematics. The research showed that to learn, connect, and communicate mathematical ideas the following must occur in collegiate classes: a) learners must be active participants in the learning process rather than passive recipients of information; b) learners should be exposed to the richness of mathematics in which a concept can be represented in several ways; c) learners should be afforded opportunities to work in groups to construct models or solve problems; d) the major thrust of the call for change is for university professors to think deeply about how they teach (Leitzel, 1991).

Teacher Collaboration and Inquiry

Field experiences are an important component in the preparation of new teachers (Berliner, 1985). Although attention has been paid to aspects of the context of the field experiences and how they might influence student teachers as they practice teach, the majority of teacher educators' research has attended to contextual influences such as cooperating teacher's beliefs, instruction, and feedback. Research on whether the site provides an environment that supports students using what they have learned in university courses is practically non-existent (Zeichner & Gore, 1990)

The research on teacher education and teaching mathematics calls not only for changes in the content and pedagogy of mathematics but also for changes in the context in which the experience is to occur. There is a need to place prospective teachers in exemplary places of practice where teachers are willing to grow and learn with their protégés. One way of addressing this need is to establish relationships with Professional Development Schools (PDS). The PDS concept has been widely implemented at many colleges and schools across the country as a way of addressing the problem confronting teacher preparation and the reform movement. As described by Darling-Hammond, et al., (1995), PDS relationships are "collaborations between school and universities that have been created to support the learning of prospective and experienced teachers while simultaneously restructuring schools and schools of education " (p.87) .

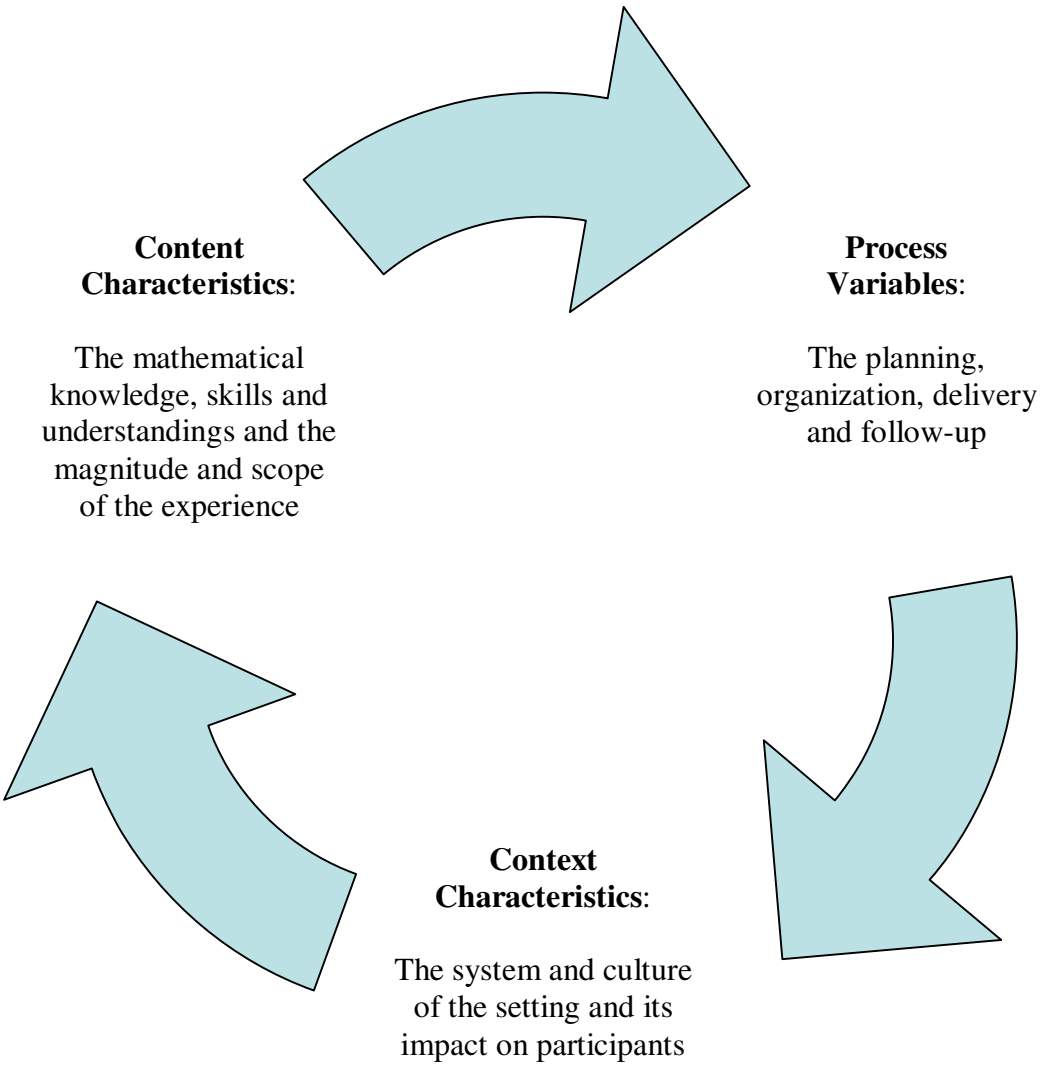
In a PDS, teacher educators and interns frequently work in teams to solve problems of practice (Haggerty & Postlethwaite, 2003). The development of new knowledge is stimulated by the exchange of ideas among interns, experienced teachers, university faculty and other professionals working on-site. Through multilayered interactions such as this, mentoring of pre-service teachers serves as a merging point for implementation of standards and other reform initiatives. Most important, the PDS offers a rich context within which to nurture and assess teacher development (Harriman, 1998). The purpose here would be to create new capacity for professionals to learn from one another, capitalize on existing capability, and thus break down the traditional isolation of teachers' work and broaden their opportunities to learn (Ball & Cohen, 1999, p. 17).

The theoretical framework for this study as seen in Table 1 was derived from the research and literature review and provided a structure from which to design and examine the teachers' improvement experience. The theoretical framework demonstrates that in order for teacher preparation programs to be more effective, those responsible, need to address not only what is to be taught, how it is to be taught, but also how it is learned and the impact of the environment on learning.

Table 1: Teacher Preparation Theoretical Framework

Proponent	Theory	Themes
Feiman-Nemser (2001)	Teacher development requires connections between pre-service, induction, and in-service	Curriculum over time Clinical experiences crucial Developmentally appropriate practices Responsibilities of university and schools Support needed in adult learning
Ball & Bass (2000)	Teaching requires understanding of the content, the learner, the learning and the teaching	Equal focus on content and process Importance of learning context
Lampert & Ball (1999)	Pre-service teachers are most influenced by their cooperating teachers and their memories of school	Reported effects of teacher preparation programs are small Lack of vision and constraints in implementation Disconnect between theory/practice and math reform/traditional pedagogy
Mueller (2003)	Teacher education programs need to include reflective practice	Work collaboratively Create learning communities Study own practices
MAA (1991)	University math courses should include connections, modeling, communication, and appreciation	See connections between content areas and real-world phenomena Model for understanding Communicate math orally and in writing Use technology Recognize historical and cultural influences
NCTM (1991)	To acquire mathematical knowledge the learner must be actively involved	Active vs passive learning Representation in varied ways Participate in collaborative group work Problem solving as a vehicle for learning
Hammond, et al. (1995) Holmes Group (1995)	To meet the needs of perspective teachers there must be a partnership between schools and universities	Requires simultaneous renewal Create professional learning communities that minimize isolation Professors and school personnel should learn together PDSs provide the context for teacher growth

Figure 1 Model for evaluating teacher development (adapted from Guskey & Sparks, 1996)



Project Design

The PDS coordinator (university professor) and the mathematics methods professor designed a study to examine the influences of a mathematics methods course taught on-site at the PDS. The PDS coordinator worked closely with the mathematics education professor to facilitate program implementation and to conduct the research. Participants (N=19) included 10 interns, and 7 cooperating teachers (grades 2-5), and 2 professors learning together as shown in Table 2.

Offering the course in the school allowed for the three groups (interns, cooperating teachers, and university professors) to come together and have hands-on experiences with children, thus providing a collaborative, job-imbedded training model. The project goals were to design and evaluate an experience that would:

- build pre-service teacher confidence
- strengthen the pre-service and in-service teacher relationship
- increase the probability that best practices were being modeled in classrooms
- challenge professors to question their own practice

Table 2 Participant Personal Profiles

Participants	Grade	Experience	Educ.	Content major	Curriculum Of Study
Cooperating Teachers					
Paula	2	7 years	BA	Elem. Ed.	Text
Teresa	2	3 years	BA	Spec. Ed.	Text
Kate	3	24 years	MA	Reading	Text
Sarah	4	4 years	MA	Spec. Ed.	Text
Nora	4	12 years	BA	Elem. Ed.	Text
Diane	5	9 years	MA	Education	Text
Karen	5	15 years	MA	Education	Text
Intern Teachers		(field work)			
Mary	2	1 semester	Soph.	Spec. Ed.	Text
Lori	2	1 semester	Soph.	Spec. Ed,	Text
Violet	2	1 semester	Soph.	English	Text
Keisha	3	1 semester	Soph.	English	Text
Janet	3	4 semesters	Junior	Psych	Text
Samantha	4	2 semesters	Soph.	Spec. Ed.	Text
Charlotte		3 semesters	Junior	Commun	Text
Lauren	4	4 semesters	Senior	Spec. Ed.	Text
Diane	4	1 semester	Soph	Commun	Text
Mia	5	2 semesters	Junior	Spec. Ed	Text
	5				
Professors					
Michele	U/G	18	ABD	Math Ed	Standards
Adriana	U/G	35	Ed.D	Ed Adm	Standards

The course was held after school, once a week for 15 weeks, in one of the elementary classrooms, so the interns could experience a full school day and the cooperating teachers could attend five of the sessions. The course objectives included applying the NCTM principles and

standards, content, and process with added attention to teaching for understanding by developing concepts in depth and connecting to everyday applications. Each session focused on the teaching of one of the content standards (numbers and operations, geometry, measurement, data analysis, patterns and algebra) while developing the five process standards (problem solving, reasoning and proof, communication, connections, and representation). Participants began each class by engaging in problem solving and sharing their solutions and strategies. Participants discussed how the content could be presented to elementary students. The professor modeled constructivist methodology asking participants to build their own knowledge and modeled strategies in different ways. Traditional pedagogy and its impact on student learning were discussed and the cooperating teachers shared the pros and cons of these approaches. When new ideas were presented to the class, the cooperating teachers offered insights into how their students might interpret and tackle the task. These discussions facilitated a more student-centered approach to teaching.

Participants later worked together to design lessons that addressed a constructivist approach using lesson study. Lesson study is a Japanese form of professional development that engages teachers in rich discussions about instructional problems and their students' learning (Lewis & Tsuchida, 1998). During lesson study, teams of cooperating teachers and interns selected a content topic or skill that presented some difficulty for their students, and then collaboratively planned an effective lesson. After planning the lesson, one cooperating teacher taught while the intern, grade level teachers and professors observed how students responded. During debriefing, the cooperating teacher, interns and professors discussed their observations and analyzed the implementation of the lesson, making revisions where they saw student misunderstandings or problems. The lesson, with modifications, was then taught to another group of students by the interns and another debriefing session was conducted. The knowledge acquired from participating in lesson study was then used to enhance class discussions.

Study and Data Sources

The descriptive study, designed as action research, was built primarily on qualitative approaches and data. The data included the expressed feelings and thoughts of the participants, why these feelings were significant, what questions were raised, and summaries of the on-site observations of the university professors. Persons from 3 groups responded to questions posed 3 months after the formal project ended: How did participating in the math methods class/lesson study experience influence you? How did the experience inform your practice? How has this experience influenced your relationship with pre-service and/or in-service teachers? Interview responses were recorded and transcribed. Data collection included field observations written informally in a researcher's journal to capture thoughts and impressions during project implementation of the project and during the next three months.

Data Analysis

Data were analyzed by each researcher separately. The researchers reviewed transcripts, seeking recurring themes and critical responses (Powell 2003). An event was considered critical in its relationship to the research questions and included positive or negative influences. After analyzing the data independently the researchers met to collaborate on findings, this provided a means for triangulation of data. Later the PDS coordinator was asked to verify the facts (Bogdan,2003) To organize patterns and themes that emerged the researchers sifted through the data and used Guskey and Spark's (1996) Staff Development Evaluation model for evaluating staff development, which is based on the premise that quality is influenced by at least three factors, content, process and context. The content characteristics addressed the mathematical knowledge, skills and understandings and the magnitude and scope of the experience. The process variables addressed planning, organization, delivery and follow-up, and the context characteristics involved the system and culture of the setting and their influence on participants. The researchers used these three dimensions (Figure 1) to organize the data and to explore and analyze themes in the theoretical framework (Table 1) to guide interpretation of the data.

Findings and Interpretations

This section combines salient findings and interpretations by providing examples of the participants' comments that highlight the events and expressed reactions of the participants. The analysis is organized using the model for examining teacher development discussed above; more specifically responses of the three parties are organized into content characteristics, process variables, and context characteristics. Table 3 summarizes the expressed benefits of the participants.

Table 3. Experienced Recorded Benefits of On- Site Mathematics Course by three groups of participants

	Cooperating Teachers	**Intern Teachers**	**Professors**
Content (what)	Awareness of need for conceptual understanding Concern with implementation Concern with constraints	Decrease in math anxiety More confident with teaching math Deeper awareness of the complexity of math	Realization that "less is more" Aware of need for more realistic approaches Aware of lack of content knowledge of teachers and students
Process (how)	Aware of role of cooperating teacher Stronger collaborations with pre-service teachers Challenged professors to question practice	Confidence with transferring skills to classroom Positive attitude toward math More empathic toward children More analytical about teaching	Challenged beliefs Realized the need for more realistic approaches Cognizant of mediocrity of state standards
Context (where)	Established community of learners Convenient schedules and locations Alignment of course assignments	Immediate opportunity for practice Supportive environment Teacher Accessibility More realistic experiences Opportunity to observe children Immediate feedback	Observation of student learning Providing feedback Access to curriculum Aware of teacher concerns and culture Allowed for demonstration and observation Concern of role of university Complexity of teaching

Content Characteristics

The responses and observations that reflected the content characteristics included themes of knowledge, skills, and understanding. After participating in the pilot, 6 of 7 cooperating teachers said that they now focus more on the process of teaching mathematics than just on the content to be taught. When asked what this meant, one said, "It's starting out everyday with a problem and getting kids to work together to solve it and then share their answers with the class". During follow-up visits the two researchers (professors) found that all cooperating teachers were implementing some strategies modeled in class, such as, use of manipulative materials, increased dialogue among students, and problem-solving strategies.

The cooperating teachers (n=7) constantly struggled with implementing learner-centered rather than teacher-directed approaches. One mentioned that teaching conceptually "was a good thing", but could not be used because of time constraints and the school structure. According to another teacher

> Parents will get upset if you don't move on in the chapter. They check on you. The Principal also wants you to be at a certain point. The other grade teachers, when we meet, will also wonder why the students are so behind in the textbook. Another problem is the State tests. You have to almost teach to those tests or you fall behind and when it comes time to take the test you would not have gotten to measurement, since it is the last chapter in the book.

The professors' field notes confirmed that the cooperating teachers were struggling with the math content. For example, one teacher incorrectly explained fraction concepts to one of the interns and was unable to clear up her own misconceptions. They constantly referred back to their own prior experiences with math and their dependency on teacher's editions.

All interns (n-10) shared that after participating in the pilot they were more confident in their teaching and their mathematics abilities; eight reported a decrease in anxiety about mathematics. One participant said, **"**After taking the course, I feel 10 times more comfortable teaching math to children because I understand it better now and I have experience with solving problems using more than one method**."** Nine participants emphasized how beneficial it was to re-learn the math concepts in a new way concurrent with learning how to teach these concepts in the classroom. A few commented that they now know they can solve a problem if they keep trying. According to one intern,

> I was very intimidated by math growing up because I was always just really bad at it. I felt that taking the math methods course made math a much better experience for me because I learned so many new ways to do problem solving.

Another said, "It taught me different methods to do problems that I always had trouble solving and therefore made me feel like I could do math".

For many years the two professors thought that the university methods course was sufficient to prepare pre-service teachers. Through the pilot study, however, they realized how much more the interns needed to know than what was usually taught. The methods professor shared that since this experience (three months ago) she has been revising how she teaches the

methods course. "It is my responsibility to close the gap between theory and practice. I can't expect my students to be able to do this when they enter the field; instead I need to help them make the connections". She commented that she will now focus on addressing children's misconceptions while teaching the interns to understand mathematics conceptually. The professor acknowledged that she must follow the "less is more" model, "I cannot address everything in one semester; instead I'll try to focus on essential learning and teach them in more depth". She shared that, "I realized that I was doing the same thing that the teachers are doing – trying to fit in everything that 'has to be covered' instead of focusing on teaching for understanding."

Process Variables

The process variables addressed actual experiences and how an on-site methods course and participation in lesson study might influence practice. Cooperating teachers generally responded that they enjoyed the experience because it allowed for better communication, but that while it was very worthwhile for the interns it did not influence them. Five stated that they enjoyed the problem-solving experiences with the interns but often questioned the need to be shown more explicitly how to do math. They wanted to address the barriers they confronted on a daily basis. One teacher said,

> Don't you know that this all requires more time, more resources and letting go of control? I often find that I can't let go because I don't know if the students are going to act up. All of this looks great in theory but can't always be done in real schools.

Another teacher shared, "The University is still living in an ivory tower as far as what is practical for day-to-day teaching. Problem-solving does not work in a typical classroom given time constraints and material that needs to be covered". All cooperating teachers (n=7) expressed that lesson study was a good way for interns to co-plan but they also said that it was too time consuming. They hesitated to give constructive feedback to the pre-service teachers since they didn't want to hurt their feelings. Professor's field notes indicated that the teachers were experiencing difficulty co-planning since they were so use to following the script found in the teachers' editions. They were learning along with the interns and did not feel secure in modeling these new techniques

Putting the interns through the actual experience of re-learning mathematics helped them to be empathic to students and analytical about their own teaching. Planning lessons with the cooperating teachers allowed the interns to understand students' prior knowledge and how they could more effectively teach them. One intern reported, "I can now relate to my students and anticipate problems they might have as I write my lesson plan". Another intern concluded,

> Having the class on-site made it easier for the cooperating teachers to participate and having them around provided the class with extra insight. I also felt that the course was

very intense - but in a good way because it allowed me to really focus on my work and put a lot of extra effort into a class that I might not have ordinarily.

Through lesson study, the interns saw the same lessons taught in a variety of teaching styles and reported that they learned the skills of observation and reflection.

The methods professor stressed that during the three months since the experience, she had been re-thinking how she teaches the methods course. "It is one thing to stress how mathematics should be taught based on the NCTM standards and how we know children learn, but I need to work in the context of the school and a teacher's experiences." The experience brought this professor closer to the everyday constraints of teaching in an elementary school, from fire alarms to assemblies to use of support staff. She also realized that many teachers are not practicing what is taught in the university. The professors felt that lesson study was very beneficial to all parties. The process of lesson study focused the participants on the learner rather than the math.

Context Characteristics

The analysis of the context characteristics addressed the school environment, roles and responsibilities, and dispositions. Cooperating teachers (n=7) stated that they had a better understanding of their role and responsibilities as cooperating teachers. One teacher said, "I still feel I have a hard time finding balance between my obligations to the children and my responsibility to the intern". Six of the teachers felt that the experience of working with the interns and with the other teachers in a risk free environment afforded them an opportunity to develop stronger relationships with each other, to see vertical planning and to assist them with their own grade level meetings.

Through our observations it was clear that the teachers' belief system was being challenged but the cooperating teachers needed more support and a change in school structure before they could transfer the ideas into teaching practices. One cooperating teacher said, "If you need to make changes in practice, you also must make changes in curriculum expectations, in standardized tests and parent and administrator perceptions of how math should be taught".

Eight of the interns reported that the pilot study influenced their attitudes. According to one intern, "One of the most important things I picked up from this class wasn't the methods for formulating the lesson plans, but rather my attitude toward teaching". All interns (n=10) appreciated that the methods course was held on-site. Several, thought that the model made it easier for the cooperating teachers to participate and to be aware of their requirements for the methods course because the cooperating teachers had an active role in the experience. Interns shared that this on–site connection made the work in the class more relevant and meaningful.

All 10 interns were very positive about the roles of their cooperating teachers. One intern described the cooperating teacher as "an inspiration and role model". The interns agreed that the

cooperating teachers were very open; they let interns see everything that they did, shared all ideas and resources and gave interns many opportunities to interact with the students. They also indicated that in past field experiences they did not feel this sense of community. The researchers witnessed strong bonds between cooperating teachers and interns. Three months after the pilot study, interns continued to visit the school to look for advice and guidance from their cooperating teacher.

The on-site pilot study served as a way for the professors to revisit and reconnect with their prior years as teachers and administrators in the elementary schools. The methods professor said, "It is one thing to stress how mathematics should be taught based on the NCTM standards and how we know children learn, but I need to work in the context of the school and the teacher's experiences." The experience made the professor more sympathetic to the role of the teacher. It raised consciousness about the children and their needs versus the theoretical perspective. It made the professor feel uncomfortable with the practice of not linking methods courses to actual classroom experiences.

The professors shared that they are more in tune to the role of interns and the constraints put on them by both their cooperating teachers and their professors. According to the mathematics methods professor, "The interns are asked to complete work in the field that often is not aligned with what the cooperating teachers are doing. The professors often have a different philosophy and ideas about teaching and the interns are caught in the middle". She said, "The interns need some support in order to understand what they see in the field".

A review of the personal profiles (Table 3) revealed that experiences and degrees earned influenced participants' willingness to take risk. This confirms the theory proposed by Feiman-Nemser (2001), which states that, the developmental nature of the adult needs to be taken into consideration when designing teacher preparation programs. The cooperating teachers with the most experience and advanced degrees seemed willing to adopt NCTM recommendations and encourage interns to do the same. The interns with two or more semesters of previous field experience were better able to apply the NCTM process standards and to reflect on the experience of lesson study than those with less field experience.

Conclusions and Recommendations

Although this study is small and limited in its ability to generalize, these researchers believe the study provides several important messages about teacher preparation in mathematics and the link between theory and practice. After the experience with the pilot mathematics program the researchers are in a better place to address the questions raised and offer recommendations. The two initial questions were collapsed into one since teacher preparation programs can only meet the needs of today's teachers by bridging the gap between the university and the school and between theory and practice. The question becomes: How can university personnel design teacher preparation programs that are successful in meeting the needs of today's teachers?

The researchers found that the study met 3 out of the 4 proposed goals: building pre-service teacher confidence, strengthening the pre-service and in-service teacher relationships,

and challenging professors to question their practices. The interns reported that the on-site course allowed for a strengthened bond with the cooperating teacher, increased their self-confidence, gave them a realistic perspective of the teaching and learning process, and gave them a greater awareness of teaching math for conceptual understanding. The professors challenged their assumptions, gained tremendous insights and began to change their practice. However, the goal of increasing the probability that best practices were being modeled in classrooms was not achieved. The researchers found that the real challenge lies in the work with the cooperating teachers. Based on the results of this study, these researchers strongly encourage the university, PDS school partners and teachers to continue to provide on-site math methods courses with added recommendations.

This section offers suggestions for how policy makers, university and school partners, can enhance the on-site experience in order to design teacher preparation programs that are successful in meeting the needs of today's teachers. The recommendations are grouped into three separate categories in order to address the unique responsibilities of each one of the stakeholders.

The university should:

- Use PDS partnerships to communicate goals and clarify responsibilities of all three parties.
- Look for ways to provide professional development for the cooperating teachers prior to the on-site course. The developmental nature of children and adults must be considered when designing learning opportunities.
- Attend to the distinct needs of the cooperating teachers and interns. Provide feedback for cooperating teachers on the value of their work with interns.
- Build into the experience opportunities for cooperating teachers to have input into syllabus and course activities. Use lesson study but provide additional training for participants. Cooperating teachers need to feel comfortable with the process before than can use it with the interns.
- Become familiar with the school culture, curriculum and resources prior to implementing course. Begin the work with cooperating teachers from their experience and then lead them to a more theoretical perspective. Learn what works for the teachers and build on successful experiences.
- Ensure that more and more faculty are offering on-site methods courses in the schools and reflecting on how the experience can improve practice. University faculty must be willing to challenge their assumptions and beliefs and examine how children learn and how teachers can better teach them.
- Follow the "less is more" theory by including less content in the methods courses.

The PDS partnership should:

- Require teachers to teach and model math for conceptual understanding. The mathematics reform requires new practices and more time than the traditional approach and therefore administrators must support the change by changing the systems and structures that hinder the change in practices, for example, of scheduling, curriculum alignment, parent expectations, and evaluation.
- Take a more active role in aligning district professional development activities with the theory and practices taught by the university and provide feedback to the university on how to make teaching more realistic for teachers and interns.
- Develop school cultures that support risk taking.

- Create an environment where teachers feel safe in voicing concerns and opinions.

The cooperating teachers should:

- Be made more aware of the importance of their role in preparing future teachers.
- Be given feedback periodically so as to feel comfortable with the supervisory role.
- Participate in designing course syllabus.
- Engage more openly during the sessions by providing feedback to the university professor.
- Commit to participating in ongoing learning opportunities and continue to examine their practices as they volunteer to mentor interns.

Although we believe that an on-site methods course with cooperating teachers and interns learning together in the field can result in a powerful teacher preparation program, more research is needed. This study was limited to 19 participants and would be enhanced by conducting both quantitative and qualitative research using a larger sample size. The knowledge gained from this study can assist others in designing a methods course that connects the work of schools and universities. Until the two worlds come together in a more unified way interns will continue to experience a disconnection between theory and practice. The real challenge is not just coming together but working together. Working together requires that both groups take ownership for teacher development and that roles and expectations be clarified with the ultimate purpose always resulting in student learning.

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