DOCUMENT RESUME

ED 470 538 SE 066 989

AUTHOR	Cwikla, Julie
TITLE	An Interview Analysis of Teachers' Reactions to Mathematics Reform Professional Development.
PUB DATE	2002-04-00
NOTE	36p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 1-5, 2002).
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC02 Plus Postage.
DESCRIPTORS	Elementary Secondary Education; *Faculty Development; Mathematics Instruction; Mathematics Teachers; *Teacher Attitudes; Teacher Background; *Teacher Education Programs; *Teacher Qualifications; Teacher Student Relationship; *Web Based Instruction

ABSTRACT

This study investigated teachers' opinions of the effectiveness of various professional development activities influencing their attention to students' thinking. The teachers' entry characteristics, nature of the activities themselves, and teachers' ratings of the activities are focused in the study. Teachers (n=110) were surveyed to rate each activity's effectiveness in prompting their attention to students' thinking. Results show that teachers' years of experience, their views of learning, and their mathematics background are correlated with their ratings of various activities. Teachers (n=13) were interviewed to extend the quantitative results and illuminate the reasons individual teachers rated particular activities as very effective to not effective at all. (Contains 42 references.) (Author/KHR)

An Interview Analysis of Teachers' Reactions to Mathematics Reform Professional Development.

Julie Cwikla, Ph.D.

University of Southern Mississippi

Paper presented at the annual meeting of the American Educational Research Association in New Orleans April, 2002

Abstract

Do particular professional development activities supporting teachers' implementation of new mathematics curricula encourage their attendance to reform-minded features of classroom practice? In particular, this study investigated teachers' report of the effectiveness of various professional development activities influencing their attention to students' thinking. The teachers' entry characteristics, nature of the activities themselves, and teachers' ratings of the activities were the focus of this study. Teachers were surveyed (N=110) to rate each activities' effectiveness in prompting their attention to students' thinking. Teachers' years of experience, their views of learning, and their mathematics background were correlated with their ratings of various activities. Teachers (N=13) were interviewed to extend the quantitative results and illuminate the reasons individual teachers rated particular activities as very effective to not effective at all.

Introduction

The National Council of Teachers of Mathematics (NCTM) developed a set of Standards (1989, 1991, 1995, and 2000) for K-12 mathematics curriculum, teaching, and assessment. The Standards build on (a) a consensus emerging in the empirical evidence in the literature describing effective practice and (b) the learning goals most valued by the mathematics education community (Hiebert, 1999). Accompanying the release of the Standards has been a surge of new mathematics curricula designed to align to the NCTM Standards.

The National Science Foundation (NSF) supported the development of many of these reform-guided curricula. These curricula claim to be aligned with the Standards and require active student investigation, collaborative activities, verbal and written communication, and various reform oriented tasks. To implement these curricula as the authors intend, the teacher's role must shift to accommodate the new curricular and task demands. The curricula do not rely on traditional lecture-style formats and the teachers are expected to redefine their role in the classroom. Students' mathematical understanding, participation, and mathematical explanations are central to these new curricula and the teacher's role has shifted to more of a facilitator of students' thinking than a presenter of procedures.

To help teachers' transition to the NCTM Standards inspired-curricula, the NSF has funded projects nationwide called "Large-Scale Systemic Change Initiatives" (LSCI) to help train and support teachers in the use of these new materials. Included in these initiatives are professional development programs to help teachers implement lessons, understand the content, assess their students' learning appropriately, and facilitate productive classroom exchange and collaboration.

Given that teachers are working with materials aligned with the NCTM Standards, it is reasonable to suspect that teachers might become more attentive to the ideas central to the mathematical reform agenda by using and learning about the curriculum. One of the NCTM Standards (2000) claims that "effective mathematics teaching requires understanding what students know and need to learn, and then challenging and supporting them to learn it well" (p.16). To follow the above NCTM recommendation it is necessary for teachers to investigate their students' mathematical thinking and learning. Therefore, might teachers become more aware of students' thinking by using and studying these NSF curricula?

It has been documented that when professional development activities focus on students' thinking, they can have a positive effect on teachers' instructional practices and provide support for teachers' continued growth (Franke, Fennema, Carpenter, Ansell, & Behrend, 1998, Simon & Schifter, 1991). Could similar results be expected under less focused and controlled situations, such as in the case of the NSF large-scale systemic change initiatives? This study investigated teachers' attention to student thinking in the context of various types of professional development activities designed to support reform driven curricula.

Problem Statement

Attending to students' thinking when planning and implementing instruction is one of the hallmarks of reform-minded practice (NCTM, 2000). Because the new reform inspired curricula aim to engage students more actively in solving problems and expressing their ideas, students' thinking can become more visible and easier for teachers to detect. Professional development activities designed to support the implementation of these curricula might directly or indirectly prompt teachers to attend more carefully to students' thinking. If this were true, it would be an important outcome of these activities.

Documenting the effect of these professional development activities on teachers' attention to students' thinking is not enough, however, to improve the effect of such activities. More information is needed on the factors that influence the effect of these activities. In this study, I investigate two factors: (a) the nature of the activities themselves and (b) the entry characteristics of the teachers.

Many of the NSF supported professional development programs that support the new curricula contain a variety of activities. It is likely that some activities have a stronger effect on teachers' attention to students' thinking than others do. But what kinds of activities have such effects? Also, it is likely that some teachers respond to these activities differently than others. But what entry characteristics influence teachers' reactions? The key is to find a way of classifying professional development activities and teacher characteristics that might relate to changes in teachers' attention to students' thinking. The literature provides some useful direction.

Background

Nature of Professional Development Activities

One way to summarize the diverse literature on professional development is to tease out the factors, found throughout the literature that seem to characterize effective development programs. Although confirming empirical data are sketchy, many researchers are hypothesizing that effective professional development is based on various principles or frameworks of design (e.g. AFT, 1995; Corcoran, 1995; Guskey, 1997; Guskey & Sparks, 1991; Hawley & Valli, 1999; Lampert & Ball, 1999; Orlich, 1989; Showers, Joyce, & Bennett, 1987; Sparks & Loucks-

Horsley, 1989; Sykes, 1996). Embedded in some of these lists of recommendations are the beginnings of learning goals and possible mechanisms to achieve those goals. However, the literature usually does not describe professional development explicitly in terms of teachers' learning goals and the mechanisms to achieve those goals (Cwikla, 2001). In fact, the constructs of learning goals and mechanisms for teacher development often are not distinguished.

There are several obstacles to setting learning goals for teachers such as teacher isolation and current measures used to evaluate professional development (Cwikla, 2001). However, despite obstacles to setting learning goals for teachers there is an emerging and rather striking consensus regarding the core mechanisms of effective professional development. This has been enabled by a vague notion of the goals of professional development but the learning goals for teachers are usually not made explicit (Cwikla, 2001). These mechanisms are viewed best as *hypotheses* (described below) that should be investigated empirically. Drawn from many accounts of personal experiences, and small-scale studies, they are being endorsed by many writers in the field. Aside from several detailed research studies, such as those conducted as part of the Cognitively Guided Instruction (CGI) (e.g. Carpenter, Fennema, Peterson, Chiang, & Loef; 1989; Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996) and SummerMath programs (Schifter & Fosnot, 1993; Simon & Schifter, 1991), relatively little data have been reported that address these hypotheses directly in mathematics so it is difficult to know exactly how these emerging mechanisms facilitate teachers' learning and changes in practice in mathematics.

<u>Professional Mechanism 1: Instructional improvement is facilitated when teachers' thinking and learning is focused on students' thinking and learning (M1)</u>. Empirical evidence suggests that professional development activities should be grounded in the fundamentals of

student cognition (Carpenter, Fennema, Peterson, Chiang, & Loef; 1989; Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996; Schifter & Fosnot, 1993). Students' thinking and learning are the products of teaching, and teachers might benefit if these products are a driving mechanism of their professional development activities.

Professional Mechanism 2: Instructional improvement is facilitated by teacher collaboration (M2). Little (1982) collected interview and observation data from six schools and posited that professional development has the greatest influence when it occurs in a collegial environment where teachers believe they can learn from one another. A collaborative teacher culture that is encouraging of consistent improvement and that supports teacher development might be beneficial for reform (Ball & Cohen, 1999; Kazemi & Franke, 2000; Schifter & Fosnot, 1993; Sparks & Loucks-Horsley, 1989).

Professional Mechanism 3: Instructional improvement is facilitated by small steady change (M3). Research studies suggest that the focus of improvement should be small and intense for thorough progress in instruction (Franke, et al., In press; Schifter & Fosnot, 1993). Gallimore (1996) describes classrooms as cultural routines. One facet of the routine cannot be changed without influencing other cultural routines, shaking the classroom equilibrium creating discomfort and confusion. Changes in the learning environment last longer when teachers focus on small changes over time. Teachers need time to understand new ideas about instruction and time to convince themselves through their own professional experiences and classroom practice that instructional improvement is necessary and feasible.

Professional Mechanism 4: Instructional improvement is facilitated by teachers' experimentation and inquiry (M4). Encouraging teachers to share and conduct structured learning experiments in their classroom instruction might support teacher learning (Schifter &

Fosnot, 1993). Yet, few teacher observations of students and student learning are ever shared as part of an ongoing instructional inquiry (Little, 1999). In addition to a collaborative environment, Little's (1982) study also indicated that schools that supported a norm of experimentation were relatively more successful. "Analysis, evaluation, and experimentation" might be treated as tools of the teaching profession designed to make teachers' work more efficient and students' learning time more productive (Little, 1982; p. 339).

These mechanisms are not discrete entities or requirements on a checklist but are overlapping recommendations from the literature that might foster continuous teacher development and growth. These Professional Mechanisms were used to classify various professional development activities for analysis purposes discussed in the Method section.

Teachers' Entry Characteristics

This study investigated teacher characteristics that might be associated with teachers' attention to student thinking. Even though it is not yet possible to isolate teacher characteristics that make a difference in their response to professional development activities, the literature provides some guidance to study these characteristics. Three major themes emerge from the literature that provide tentative answers to the problem statement and guide hypothesis development. The first theme suggests that teachers' years of experience might have an effect on their reactions to particular professional development activities. The second theme indicates that teachers' views of learning might be related to the attention to student thinking teachers already practice and the likelihood that they will increase their tendency to address student thinking. The third theme suggests that teachers' mathematical background might be related to their attention to students' thinking and their desire to engage in activities focused on students' strategies.

Teaching Experience

Huberman (1995) presents a summary of the literature and a model to generate hypotheses about how years of teaching experience are associated with teacher responses to professional development. There are other teaching career phase models similar to Huberman's (1995) model (e.g. Feiman-Nemser, 1985; Huberman, 1993) and there are additional teacher development models that are not as relevant for this study because they focus only on teachers' age or attitudinal and perceptual changes (e.g. Adams, 1982; Guskey, 1989; Peterson, 1964). Huberman's model is especially useful because two of the five phases are described in ways that suggest links between teacher's orientation within a career phase and the nature of particular development activities. This study investigated these two phases.

A teaching career typically begins with two years in a "survival and discovery" phase. Teachers are confronted with the initial complexity of professional work, yet at the same time are generally enthusiastic, experience a sharp learning curve, and develop a pride in their belonging to the teaching profession (Huberman, 1995). The less experienced teachers have not been socialized into the typically individualistic and isolated teaching environment, which lacks meaningful peer interaction (Ball & Cohen, 1999; Hyde, 1992; Johnson, 1990; Liberman, 1988; Little, 1999). The more senior teachers have grown accustomed to the "politeness norm that dominates most current teacher discourse" (Ball & Cohen, 1999; p.27) whereas the less experienced teacher might welcome meaningful peer interaction maintaining the collegial attitudes of a university atmosphere they have just left. This literature provides the underpinnings of hypothesis 1.

H1: Teachers with less than two years of experience perceive professional development activities involving Professional Mechanism 2 (Collaboration) as a productive way to prompt their attention to students' mathematical thinking. They will rate these activities higher than 2.5 on a 1-4 Likert-type effectiveness scale.

Later in the teacher's career, Huberman (1995) has identified an "experimentation and diversification" phase that might emerge between seven and twelve years of experience. Teachers have come through the "survival and discovery" phase as well as a "stabilization" period and begin exploration in their teaching. This phase is characterized by a desire to increase teaching effectiveness and is enacted through "largely private experiments" in their own classroom (Huberman, 1995; p. 198). The teachers are compensating for the tentative uncertainty experienced in their initial years of teaching and want "new stimulation, new ideas" and "new challenges" (Cooper, 1982; p.81). Therefore during the "experimentation" phase teachers might be more eager to share their findings and offer guidance for other teachers. They might also be more comfortable than the less experienced teachers allowing teachers to observe them implementing a new method or practice, supporting the foundation for the second hypothesis.

H2: Teachers with seven to twelve years of experience will rate activities involving Professional Mechanism 4 (Experimentation) higher than teachers with either less or more years of teaching experience.

View of Learning

A second lens through which to examine teachers' interactions with professional development is their view of student learning. A teacher's view of mathematical learning might affect their attention to students' thinking in professional activities. Knapp and Peterson's (1995) findings suggest that teachers who view mathematics learning as knowledge construction are very likely to give more attention to student thinking, whereas teachers who maintain that knowledge is transmitted give little credence to the diversity of student thinking in their classroom or students' learning trajectories. The teachers' entry views of students' learning in this study might be associated with their perceptions of various professional development activities.

H3: Teachers who hold the most constructivist views of mathematics learning will rate all the professional development activities higher than teachers with a less constructivist view of learning in terms of prompting their attention to student thinking.

Mathematics Background

In addition to teachers' views, this study investigated the teachers' mathematics background. Middle school teachers might vary greatly in their mathematics education. In general, middle school teachers range from mathematics and mathematics education majors to uncertified teachers with no mathematics background. Teachers' mathematical background might influence the manner in which they structure their classroom (Brophy, 1991; Fennema & Franke, 1992) and impact their attention to student thinking. It is suspected that the teachers with advanced mathematical training might perceive little benefit from professional development activities focused on students' thinking, various strategies, and mathematical content because of a false ceiling effect. These teachers might not feel they are challenged during these activities. On the other hand, the teachers with a weak mathematical background might be confused and lost in a group setting. Besides the inherent problem solving barriers and stumbling blocks, there might also be a shame factor associated with lacking mathematics knowledge.

H4: Teachers with an average number of college mathematics credits within the group will rate the sessions focused on student strategies or development of the content, higher than the teachers with more or less mathematics credits. These teachers might be most interested in activities that embody Professional Mechanism 1 (Student Thinking) because their mathematics foundation allows these activities to be accessible but still leaves room for learning

There might be other explanations for the differences in teachers' responses to various types of professional development activities, but this study focused only on these three specific teacher characteristics.

Method

Participants

The participants were a voluntary sample of 110 teachers from a population of approximately 200 middle school teachers in a mid-Atlantic State. All of these teachers were participating in a statewide mathematics professional development program supported by the National Science Foundation. Each teacher was being trained to use new mathematics curriculum materials. Some teachers were in their third year of professional development and others were in their first or second year of professional development.

The professional development program had a two-week summer program for the first year teachers and a one-week program for the second and third year teachers. All teachers also participated in on-site professional development activities throughout the school year that blend year one, two, and three teachers. The on-site support varied by district. In some districts, teachers met in the afternoon on-site for an hour, weekly or bi-weekly for one to two hours, and/or participated in monthly three-hour training sessions. In other districts, teachers grouped by grade level or curriculum met weekly or monthly.

Most public schools in the State had chosen to use one of two reform driven curricula at the middle school level. Teachers in these schools were required to attend the professional development activities. This mandate increased the likelihood of a well-stratified sample of teachers from across the State that was not limited to the usual set of volunteers and self-motivated teachers. But only teachers who granted explicit permission were included in the study.

Data Collection

Survey Constructs

The teachers filled out a written survey after they had experienced a variety of professional development activities halfway through an academic year. The professional development program included mathematics content and pedagogy focused sessions, study groups about each curriculum, whole group 'expert' presentations, small group lesson preparation, and other forms and content. None of the session facilitators explicitly claimed the goal of any particular activity to be increased teachers' understanding of student thinking but it was a theme woven into most of the activities.

The survey included items that investigated teachers' reactions to the various forms of professional development and activities that prompted teachers' attention to student thinking. The survey consisted of three sections (See Appendix A). (a) The first measured teachers' views of student learning and the degree of constructivist notions. (b) The second explored teachers' reactions to specific forms of professional development in prompting their attention to students' mathematical thinking. (c) The third portion collected demographic information.

The teachers' views-of-student-learning portion of the survey consisted of 18 items. Teachers reported their views of student learning on a 1-4 Likert-type scale. The items were constructed to classify teachers' views of student learning into two degrees of constructivism: (a) learning occurs with less student construction and (b) learning requires more student construction. A factor analysis of the 18 items was conducted using a principal component analysis with a Promax rotation. The Structure Matrix was analyzed and the differences between the components for each item verified one of the two factors operating on all of the 18 items.

The professional development portion of the survey asked teachers to rate each type of professional development activity on a 1-4 Likert-type scale. A 1 indicated that the session did *not* prompt their attention to students' thinking and a 4 that the session was very effective in this regard.

Prior to survey administration, I coded each of the activities into one of the four Professional Mechanisms of effective professional development. Each activity was rated on a 1-3, weak to strong scale according to the presence of each Professional Mechanism (See Appendix B). A second researcher who served as the program's evaluator and had observed many of the professional development sessions since its inception, also coded each activity. Inter-rater reliability was achieved with 100% agreement on the classification of each activity. When the mechanisms were rated on a 1-3 scale of strength there was an 83% agreement between the evaluator and myself.

The third section of the survey consisted of demographic questions asking teachers to provide information about their years of teaching experience, age, educational background, mathematics background, teaching certification, gender, and their years of involvement in the professional development program. The purpose of this portion of the survey was to collect information about participant teachers' characteristics.

Follow-up Investigation

Each of the hypotheses guided the analyses of the survey data. To gain insight into the reasons for teachers' survey responses and why the hypotheses were confirmed or not confirmed the investigation shifted to focus on individual teachers. The goal was to develop some deeper explanations for the relationships between teacher characteristics, professional development activities, and prompting teachers' attention to student thinking.

Eighteen teachers were contacted by telephone to verify their survey responses regarding demographic information and professional development ratings. If the researcher judged the teacher to be an informative resource, the teacher was asked to participate in a longer in person interview. Before the telephone calls were made teachers were organized into groups by the characteristic investigated in each hypothesis. An attempt was made to select teachers that were stratified along the other variables in this study to obtain a diverse sample.

Teacher Interviews

Thirteen teachers were interviewed in-person after one teacher declined an interview, two did not return multiple phone calls, and two others were rejected because the researcher judged the teachers not to be a productive source of information by their answers in the phone follow-up. One of the teachers that was rejected did not seem interested in talking about her professional development experience and during the follow-up conversation, responses were typically one word answers. The other teacher that was rejected did not stay on task and her answers wandered from the intent of the question or she simply repeated herself.

The thirteen interviews were recorded and transcribed. For each hypothesis (H1) the "survival and discovery" group, (H2) the "experimentation" group, and (H4) teachers with an average number of college level mathematics credits, three teachers were interviewed. Four teachers were interviewed for the third hypothesis that investigated teachers' views about learning and their reactions to professional development activities. Of the four, two teachers were chosen from each of the extreme ends of the constructivist groups based on their survey responses.

In-depth interviews were conducted to inform the affirmation or refutation of each of the primary hypotheses. The in-person interview addressed the survey questions and asked teachers for specific examples and details about their professional development experiences and how the activities impacted their understanding of students' thinking.

The survey items and interview questions were informed by my knowledge of the teachers' professional development experiences. I observed varieties of professional development formats during the summer institutes (1999, 2000). Observations continued into the academic year (2000-2001) during on-site school based meetings in the afternoons and evenings. The observations provided background information to better understand what the teachers were experiencing. The observations provided first-hand knowledge needed to develop the survey instrument and interview protocol, and provided a basis for meaningful interactions with the participating teachers.

Results

The results section reports the hypotheses testing using the survey data. The qualitative data collected during the teacher interviews will be reviewed in the discussion section to inform the results of the hypothesis tests. The goal is to provide both a quantitative and qualitative description of teachers' reports about their attentiveness to students' thinking and the professional development activities that influence that attention.

Hypotheses Tests

An alpha level of .05 was used to determine significance for all statistical tests. Hypothesis 1 was tested using the professional development ratings of the 20 teachers in the sample with less than two years of teaching experience. The teachers in Huberman's (1995) "survival and discovery" phase rated all four activities that incorporated Professional Mechanism 2 (Collaboration) higher than 2.5 on a 1-4 Likert-type scale (See Table 1 and Appendix B). The t-test confirms that all of the means are significantly greater than 2.5, rejecting the null hypothesis. This means that teachers with less than two years of experience rated the activities that involved collaboration effective or very effective on average.

Table 1: Teachers' Ratings with less than two years of experience

---

Insert Table 1 Here

Hypothesis 2 was tested using a multivariate analysis of variance (MANOVA). The hypothesis posited that teachers with 7-12 years of teaching experience would respond more highly to activities that involved Professional Mechanism 4 (Experimentation) than teachers with less or more years of experience. There were four dependent variables, activities 3, 4, 6, and 9; and three levels associated with teachers' years of experience, 0-6 years, 7-12 years, and more than 12 years (See Appendix B). Although the means were in the direction hypothesized, no significant differences were indicated by Wilk's criterion across the teachers' years of experience and their ratings of activities exhibiting M4 (Λ=. 662). A power analysis indicated a relatively low level of power (Power = .32), possibly the result of the small sample in the 7-12 years of experience group. The MANOVA, which analyzes only the cases that rated all four activities, did not produce results significant to reject the null hypothesis. The descriptive statistics for each of the teacher groups are detailed in Table 2. Activities exhibiting M4 were further explored during the teacher interviews.

Table 2: Teachers and their Mean Ratings & SD of M4 Activities

---

Insert Table 2 Here

Hypothesis 3 was also evaluated using a MANOVA. The degree of constructivist views of the learning of the 110 teachers spread across a continuum. To form two distinct groups, twenty teachers were chosen who held views of learning that were most different. Teachers' ratings were averaged for all activities classified by each of the four Mechanisms M1 - M4. Wilk's criterion confirmed that teachers who hold a view of learning as more constructed rate all professional activities higher with regard to prompting their attention to students' thinking ($\Lambda = .007$, Power = .884). The descriptive statistics are summarized in Table 3.

Table 3: Teachers' Views of Learning, their Average Ratings, and S.D.

Insert Table 3 Here

The univariate results also provided significant results indicating that the "more constructivist" teachers rated each of the professional activities higher than the "less constructivist" teachers did.

Table 4: Univariate Results for each Professional Principle

Insert Table 4 Here

Hypothesis 4 was investigated using a MANOVA. The Wilk's criterion (Λ=. 041, Power = .821) indicated significant results for the interaction between teachers' number of university level mathematics courses and their ratings of activities exhibiting MI (See Appendix B). The average number of mathematics courses for the entire sample of middle school teachers surveyed was 6.98 and teachers were included in the "average" group if they were within ½ a standard deviation on either side of the mean. Examining the univariate statistics shows significant differences for two of the four activities (See table 5).

Table 5: Univariate Results for each M1 Activity

Insert Table 5 Here

Significant differences across teacher groups for Activities 3 and 6 were detected. But the power of this test was especially low for activities 5 and 11 and might account for the lack of significant differences in these cases. However, the means for activity 11 show very little between-group difference. Many of the teachers reported that they could not remember how many mathematics courses they had taken and left the item blank on the survey. The descriptive statistics are reported in Table 6.

Table 6: Teachers and their Mean Ratings & SD of M1 Activities

---

Insert Table 6 Here

Discussion

The discussion section reviews the results of the hypothesis tests and augments the findings with excerpts from the teacher interviews. The goal of the teacher interviews was to inform teachers' ratings of professional activities on the survey. When the teachers were interviewed regardless of the hypothesis being investigated, the teachers did not keep their responses focused only on students' thinking. It seemed the teachers were rating the activities on a range of goals they had in mind instead of restricting themselves to only the activity's effectiveness in prompting their attention to students' thinking. As a result some of the teacher comments included in the discussion are more general reactions to an activity's effectiveness and not necessarily with respect to students' thinking. It is possible that teachers rated the activities on the survey in a similar way without restricting their ratings only to an activity's effectiveness in prompting their attention to student thinking. Each hypothesis will be discussed followed by themes that emerged from the interview data. Pseudonyms are used for the teachers interviewed.

Hypothesis 1

Teachers with less than two years of experience rated all collaborative activities (M2) as "effective" or "very effective" in impacting their attention to students' thinking. However, during the interviews the teachers conveyed both positive and negative collaborative experiences. The positive experiences were with teachers from other schools and other grades, and the negative interactions were with teachers in their own building.

The inexperienced teachers reported that collaboration with their peers working through mathematical tasks together was helpful in understanding students' thinking. This is illustrated in the following excerpt from Mark a first year teacher.

> "When you see how other peers' minds are thinking. You know, 'Oh, I didn't think about that one.' . . . And they can actually explain it to you. . . because they are math teachers also. . . As opposed to, if you were to hear a student form a question for the first time. . . Whereas a peer teacher was able to explain the whole thinking process" (Mark, March 2001; p.3).

This collaborative activity and others the teachers discussed were part of the formal training provided through the local systemic change initiative in district wide or Statewide programs. The teachers had not experienced such positive interactions in their school on a daily, weekly, or monthly basis in general. Eileen expressed a frustration with the peers in her building during their after school meetings to discuss the reform curriculum.

> "I don't know if they just think that I'm too optimistic. I'm not sure. Because, when we do have meetings like I said, they're so negative. And it's frustrating to me, because I'm so positive about everything. I know the kids can do it. I've seen them do it" (Eileen, March 2001; p.9)

The interviews suggest that the three inexperienced teachers had experienced some effective forms of collaboration with their wider peer group, but each also recalled negative instances of building level interactions. Despite the varied levels of effectiveness reported during their interviews, they retained the view that collaboration could be an important mechanism for their own learning about students' thinking as conveyed in their survey ratings. If other beginning teachers in the sample share their faith in the benefits of collaboration despite the possible lack of local support, it is not surprising that such activities received high ratings on the survey.

Hypothesis 2

The statistical results from the test of Hypothesis 2 were inconclusive. There were no significant differences between the groups with different years of experience on their ratings of activities that involved experimentation and inquiry. However, the average ratings for the groups of teachers were in the direction of the hypothesis and three teachers in the "experimentation and diversification" phase with 7-12 years of experience were interviewed. The interviews provide some specific details about what these teachers found beneficial to enhance their understanding of students' mathematical thinking, within the professional activities involving experimentation (M4). The experimentation and inquiry teachers spoke more of the mechanisms to improve their practice in general straying from the focus on students' thinking in the interview protocol. It is possible that these three teachers did not view the development of an understanding of students' thinking as a critical learning goal of the professional training.

Maria, a teacher with seven years experience reported the benefits of journal reading to improve her instruction and student learning.

> "Just finding other strategies, sample problems, the way that teachers kind of change and tweak different parts of the books, and curriculum they're using. Just hearing about other things, how other teachers are doing, as well as giving me ideas of how I can change my teaching to be more effective for the kids" (Maria, April 2001; p.6).

Leslie, another "experimentation" teacher described a teacher support group that has been established at her school. This group meets weekly after school to explore the curriculum, the difficulties teachers are encountering, and has some underpinnings of the Japanese lesson study (See Stigler & Hiebert, 1999).

> "The support here at the school that we've established, . . . being able to also use somebody else as a sounding board. 'Here's a lesson I'm really struggling with. Here's a concept I'm really struggling with, can you help me? Here's something my kids are really struggling with. Any ideas? Any suggestions?'" (Leslie, April 2001; p.14).

An understanding of students' thinking is embedded in the conversations about specific lessons Leslie experiences in her school. However, understanding students' thinking might not be an explicit goal of the lesson-study type meetings these teachers have constructed.

The three experimentation teachers interviewed conveyed a sense of confidence in their teaching. They were also explicit about the methods they use to improve their practice. The professional development experiences they reported as beneficial range from observers in their classroom and journal reading, to lesson study type activities and watching classroom videos, yet their comments were not solely focused on understanding students' thinking. Similar to the first hypothesis the teachers' more general comments about the effectiveness of particular activities during the interviews might indicate that their ratings on the survey were also not limited to prompting their attention to students' thinking.

Hypothesis 3

Teachers with a more constructivist view of learning rated all the professional development activities more effective in impacting their understanding of students' mathematical thinking compared to teachers with a less constructivist view of learning. To further investigate the confirmation of Hypothesis 3 four teachers were interviewed, two with more constructivist and two with less constructivist views of learning.

Joanne classified as a more constructivist teacher commented about the professional activities that modeled the mathematics activities for the teachers as students and "that kick" of understanding that she has experienced.

> "The only way we're going to get teachers to better do this is if the teachers are put through the exact thing their kids are put through. So that they can develop the concept too. And when they get that kick then they're going to understand what that kick does to the kid" (Joanne, March 2001; p. 9).

Joanne reported the benefit of actually experiencing the exploration and investigations the students are required to explore because it helps teachers understand the concepts and what students are thinking as they struggle through the tasks. Whereas Sally, classified as a less constructivist teacher, countered that opinion and sees no value for teachers working through the tasks to analyze their own or their students' thinking. "I don't know that all the time we should have to do the problem . . . I mean the kids actually have to do it. But for all of us to sit there and do that, I think it's kind of a waste of time" (Sally, April 2001; p.2).

The more and less constructivist teachers have different opinions about the effectiveness of some of the professional activities and the importance of understanding students' thinking. Both more constructivist teachers reported working through the curricular tasks as influential in their understanding of students' thinking. Whereas the less constructivist teachers did not find value in studying students' strategies or in working through the curriculum tasks to help develop their understanding of students' thinking. However, observing other teachers was an activity both groups of teachers interviewed agreed would be a good way to improve their instruction. Similar to the previous group of teachers interviewed, their comments were not confined strictly to the goal of understanding students' thinking when they discussed the benefits of classroom observations.

Hypothesis 4

Teachers with an average number of mathematics courses responded significantly more positive to two of the four M1 activities than teachers with less or more university mathematics courses. The M1 activities are focused on students' mathematical thinking and strategies, and are more content focused than the other activities. Ann, a teacher who has completed less than the average number of university mathematics courses within the group said,

> "People who are really comfortable . . . assume that you have a higher level of knowledge than you have. So as much as it's been explained to me a little bit, I don't feel that I have all the pieces. At least not so I feel confident . . . the gap is, in teaching it to the kids . . . (I) don't have the repertoire of different angles to come at it" (Ann, April 2001; p.9).

Ann is aware of her limited mathematics background and that has impacted her understanding of students' thinking because she is not always able to offer multiple strategies to help students understand. Unfortunately, she is not finding the support for her lack of conceptual knowledge in the professional activities she has experienced and at times feels lost. "There may be other concepts that people have that they don't have a good knowledge of . . . Like, I would just like a little lesson in there" (Ann, April, 2001; p.8).

Leslie, a sixth grade teacher with an average mathematics background shared how teachers with an average mathematical background can feel comfortable learning from those with more content expertise. During this activity, the curriculum was modeled for the teachers as students.

> "We as 6th grade teachers . . . would solve something totally different, very visual. We were drawing those little pictures and things like that. And some of the 7th and 8th grade teachers were, like, not laughing at us, but laughing because of the different way(s). Where they approached a problem, maybe algebraically, with a formula, we approached it totally different. Probably how our students would. Because we weren't as familiar with the math behind it as they were. So we were trying to approach it in a totally different way. And we learned a lot from each other in doing that" (Leslie, April 2001; p.2).

The teacher who had completed more university mathematics courses was not as inspired by the sessions focused on students' strategies and development of the content. Eileen reported, "There was a lot more time spent doing, you know, catching up the non math people and telling them "This is what we're doing, this is why we're doing it" (Eileen, March 2001; p.12). However, she added, "I could have gotten a lot more out of it, if it had just been math people, like, just math nerds, ready to talk about math and how to help the kids" (Eileen, March 2001; p.2).

The interviewed teachers' mathematics background seemed to be a significant determinant of their responses to various activities with student work, student strategies, and working through mathematical tasks. The excerpts from the interviews illuminate the reasons teachers rated these activities high or low. The teacher with a higher than average mathematics background interviewed was not challenged during the M1 activities, while the teacher with a lower than average mathematics background reported a need for "little lessons" to review gaps in her content knowledge. Leslie, a teacher with an average number of mathematics courses found the M1 activities helpful and she enjoyed learning from other teachers with more content expertise. Based on these responses, it is likely that mathematics background played an important role in the difference that were found among these groups on the survey.

Conclusions

Teachers' entry characteristics and views of learning do seem to influence their response to professional development activities. Given the frequent ambiguity of goals and mechanisms in professional development and the failure to distinguish between them this study began by narrowing the focus to one goal and several mechanisms. The goal of prompting teachers' attention to students' thinking was investigated by assessing teachers' ratings of various professional activities. The literature guided the development of possible relationships, or hypotheses between teachers' characteristics and their responses to the different mechanisms.

This study found that inexperienced teachers have a great faith in teacher collaboration, despite some negative experiences. In addition, teachers' views of mathematics learning are predictive of their responses to professional development activities focused on reform-minded curriculum. The more constructivist teachers consistently rated activities more effective than teachers with a less constructivist view of learning. Finally, this study determined that teachers' mathematics background is a significant determinant of teachers' reactions to particular activities focused on students' mathematical thinking and development of the curriculum.

Although the findings suggest some specific relationships, the interview responses indicate that the teachers might not hold these relationships in such a specific way. Their comments often drifted away from the goal of attention to students' thinking and addressed more general goals, such as "improved instruction." This suggests that teachers also might have responded on the survey in terms of an activity's general benefit rather than its influence on their attention to students' thinking.

During the teacher interviews it became apparent that the teachers were not focused on understanding students' thinking and did not view it as a primary goal of the professional development program. Despite the reform-minded curriculum and the emphasis of the NCTM Standards (1989, 2000) during their training this goal was not explicit for the teachers as they came to understand the curricula and their shifting teacher role. The teachers focused their responses on other more general instructional concerns. I have argued elsewhere that teacher learning goals need to be made the focus of professional development for the developers and for teachers as learners (Cwikla, 2001). Otherwise the purpose of the professional activities remains at the "improve student learning" level and ongoing teacher learning remains loosely defined and it is difficult to assess a professional program's effectiveness.

Next steps for investigation of the four mechanisms might move beyond the teacher self-report data and into the classroom to investigate teachers' use of students' thinking in their practice. How do these professional mechanisms translate into teachers' classroom practice and eventual changes in student understanding? Future research might also investigate particular features of the various activities and the format in which they are presented. How do variations in the professional activities and mechanisms influence teachers' learning?

The growing shortage of properly trained teachers, efforts to reform mathematics education, accountability mandates in this country, and impoverished teaching compel intense examination of professional development and the ways to enhance existing teaching. The ultimate goal is to improve the learning environment for students, and this should begin by improving the learning environment for teachers.

Table 1

	$\bar{x}$	SD	t-test
Activity 2	3.13	.83	15.19
Activity 3	3.23	.75	19.54
Activity 7	3.09	.94	13.14
Activity 8	3.05	.70	16.46

Table 2

Experience	N	Activity 3	Activity 4	Activity 6	Activity 9
0-6 Years	44	3.20	2.90	2.75	3.06
		(.73)	(.78)	(.71)	(.81)
7-12 Years	17	3.29	3.20	3.16	3.30
		(.62)	(.86)	(.98)	(.67)
12+ Years	34	3.03	2.91	2.80	2.60
		(.82)	(.83)	(.95)	(.83)

Table 3

	N	M1	M2	M3	M4
More	20	3.33	2.95	3.20	3.40
Constructivist		(.51)	(.66)	(.57)	(.49)
Less	20	2.75	2.49	2.59	2.76
Constructivist		(.48)	(.38)	(.45)	(.41)

Table 4

Dependent	F	Sig.
M1	11.545	.002
M2	6.846	.013
M3	12.252	.001
M4	17.683	.000

Table 5

Dependent	F	Sig.	Power
Activity 3	3.655	.032	
Activity 5	.8310	.418	.19
Activity 6	3.618	.034	
Activity 11	.147	.864	.07

Table 6

No. Mathematics Courses	N	Act. 3	Act. 5	Act. 6	Act. 11
Low	15	3.29	2.57	3.09	2.91
		(.71)	(.88)	(.90)	(.79)
Average	31	3.30	2.80	3.14	2.92
		(.74)	(.95)	(.91)	(.76)
High	11	2.75	2.66	2.38	2.88
		(.77)	(.84)	(.65)	(.78)

References

Adams, R. (1982). Teacher development: A look at changes in teachers' perceptions across time. *Journal of Teacher Education, 33*(4), 40-43.

American Federation of Teachers (1995). Principles for professional development. AFT's Guidelines for creating professional development programs that make a difference.

Ball, D.L., & Cohen, D. (1999). Developing practitioners: Toward a practice-based theory of professional development. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco, CA: Jossey-Bass.

Brophy, J.E. (1991). Conclusion to advances in research on teaching, Vol.2: Teachers' knowledge of subject matter as it relates to their teaching practice. In J.E. Brophy (Ed.), *Advances in research on teaching: Teachers' subject matter knowledge and classroom instruction Vol. 2* (pp. 347-362). Greenwich, CT: JAI Press.

Carpenter, T.P., Fennema, E., Peterson, P.L., Chiang, C., & Loef, M. (1989). Using knowledge of children's mathematics thinking in classroom teaching: An experimental study. *American Educational Research Journal, 26,* 499-531.

Cooper, M. (1982, April). *The study of professionalism in teaching.* Paper presented at the American Educational Research Association, NY.

Corcoran, T. (1995). *Helping teachers teach well: Transforming professional development* (RB-16). Philadelphia: Consortium for Policy Research in Education.

Cwikla, J. (2002, April). *The importance of setting learning goals to investigate the* *effectiveness of teacher professional development.* Paper presented at the American Educational Research Association. New Orleans, LA.

Cwikla, J. (2001). *Mathematics teachers' report of the influence of professional development activities on their attention to students' thinking.* University of Delaware, unpublished doctoral dissertation.

Feiman-Nemser, S. (1985). Learning to teach. In L. Shulman & G. Sykes (Eds.), *Handbook of teaching and policy* (pp.150-170). New York, NY: Longman.

Fennema, Carpenter, Franke, Levi, Jacobs, & Empson (1996). A longitudinal study of learning to use children's thinking in mathematics instruction. *Journal for Research in Mathematics Education, 27* (4). 403-434.

Fennema, E. & Franke, M.L. (1992). Teacher's knowledge and its impact. In D.A. Grouws (Ed.) *Handbook of Research on Mathematics Teaching and Learning.* Macmillan Publishing, New York, NY.

Franke, M.L., Carpenter, T.P., Levi, L., & Fennema, E. (2001). Capturing teachers' generative change: A follow-up study of professional development in mathematics. *American Education Research Journal, 38* (3), 653-690.

Franke, M.L., Fennema, E., Carpenter, T.P., Ansell, E., & Behrend, J. (1998). Understanding teachers' self-sustaining change in the context of professional development. *Teaching and Teacher Education, 14* (1), 67-80.

Gallimore, R. (1996). Classrooms are just another cultural activity. In D. L. Speece & B.K. Keogh (Eds.), *Research on classroom ecologies: Implications for inclusion of children with learning disabilities* (pp. 229-250). Mahwah, NJ: Erlbaum.

Guskey, T. (1997). Research needs to link professional development and student learning. *Journal of Staff Development, 18 (2), http://www.nsdc.org/educatorindex.htm*

Guskey, T. (1989). Attitude and perceptual change in teachers. *International Journal of Educational Research, 13*(2), 439-454.

Guskey, T., & Sparks, D. (1991). What to consider when evaluation staff development. *Educational Leadership, 49,* 73-76.

Hawley, W.D. & Valli, L. (1999). The essentials of effective professional development: A new consensus. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 127-150). San Francisco, CA: Jossey-Bass.

Hiebert, J. (1999). Relationships between research and the NCTM Standards. *Journal for Research in Mathematics Education, 30,* 3-19.

Huberman, M. (1993). *The lives of teachers* (J. Neufeld, Trans.). New York, NY: Teachers College Press.

Huberman (1995). Professional careers and professional development. In Guskey, T.R. & Huberman, M. (Eds.) *Professional development in education: New paradigms and practices* (pp. 193-224). Teachers College Press, New York, NY.

Hyde, A. (1992). Development of a willingness to change. In A. Hyde and W. Pink (Eds.), *Effective staff development for school change* (pp. 171-190). Norwood, NJ: Ablex Publishing Corporation.

Johnson, S.M. (1990). *Teachers at work: Achieving success in our schools*. New York: Teachers College Press.

Kazemi, E. & Franke, M.L. (2000, April). *Teacher learning in mathematics: A* *community of practice perspective.* Paper presented at the American Educational Research Association. New Orleans, LA.

Knapp, N.F., & Peterson, P.L. (1995). Teachers' interpretation of "CGI" after four years: Meanings and practices. *Journal for Research in Mathematics Education 26* (1), 40-65.

Lampert, M. and Ball, D.L. (1999). Aligning teacher education with contemporary K-12 reform visions. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 33-53). San Francisco, CA: Jossey-Bass.

Lieberman, A. (Ed.) (1988). *Building a professional culture in schools.* New York: Teachers College Press.

Little, J.W. (1982). Norms of collegiality and experimentation: Work-place conditions of school success. *American Educational Research Journal, 19* 325-340.

Little, J.W. (1999). Organizing schools for teacher learning. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 233-262). San Francisco, CA: Jossey-Bass.

National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (1995). *Assessment standards for school mathematics.* Reston, VA: Author.

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

Orlich, D.C. (1989). *Staff development: Enhancing human potential.* Boston: Allyn & Bacon.

Peterson, W. (1964). Age, teacher's role, and the institutional setting. In B. Biddle & W. Elena (Eds.), *Contemporary research on teacher effectiveness* (pp. 264-315). New York, NY: Holt, Rinehart.

Schifter, D. & Fosnot, C.T. (1993). *Reconstruction mathematics education: Stories of teachers meeting the challenge of reform.* New York, NY: Teachers College Press.

Showers, B., Joyce, B., & Bennett, B. (1987). Synthesis of research on staff development: A framework for future study and a state-of-the-art analysis. *Educational Leadership, 45*, 77-87.

Simon, M.A. & Schifter, D. (1991). Towards a constructivisit perspective: An intervention study of mathematics teacher development. *Educational Studies in Mathematics, 22* 309-331.

Sparks. D. & Loucks-Horsley, S. (1989). Five models of staff development for teachers. *Journal of Staff Development, 10,* 40-57.

Stigler, J. W. & Hiebert, J. (1999). *The Teaching Gap.* New York, NY: The Free Press.

Sykes, G. (1996). Reform of and as professional development. *Phi Delta Kappan, 77,* 465-467.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: AN INTERVIEW ANALYSIS OF TEACHERS' REACTIONS TO MATHEMATICS REFORM PROFESSIONAL DEVELOPMENT	
Author(s): JULIE CWIKLA	
Corporate Source: AMERICAN EDUCATIONAL RESEARCH ASSOCIATION	Publication Date: APRIL 2002

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 1	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2A	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2B
Level 1 ☑	Level 2A ☐	Level 2B ☐
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Signature: [signature]	Printed Name/Position/Title: JULIE CWIKLA / ASST. PROF	
Organization/Address: UNIV. SOUTHERN MISS. 244 LOVERS LN. OCEAN SPRINGS, MS 39564-2833	Telephone: 228 547 6547	FAX:
	E-Mail Address: julie.cwikla@usm.edu	Date: 8/02

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, or, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706

Telephone: 301-552-4200
Toll Free: 800-799-3742
FAX: 301-552-4700
e-mail: info@ericfac.piccard.csc.com
WWW: http://ericfacility.org

EFF-088 (Rev. 2/2001)