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Chapter 6

Teacher Learning and the Acquisition of Professional Knowledge: An Examination of Research on Contemporary Professional Development

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In the past 10 years, the calls for a commitment to teacher learning have increased exponentially, most likely from a confluence of forces. The standards movement is one such force. Calls for higher standards for teachers inevitably erupted alongside calls for higher standards for students. If students needed their education served up differently in order to meet new assessments and standards, it followed that teachers would need something new as well (e.g., Cohen & Ball, 1990). Reformers began to note that changed curriculum and testing would not directly lead to changed teaching practices. New measures of student performance would entail new ways of teaching. Professional development was touted as the ticket to reform.

Mounting efforts to increase the professionalization of teaching constitutes yet another force. Groups such as the National Council of Teachers of Mathematics (1989, 1991), the National Council of Teachers of English (1996), the National Board for Professional Teaching Standards (1989), and the Interstate Consortium of Chief State School Officers (Council of Chief State School Officers, n.d.-a, n.d.-b) have authored mission statements and subsequent standards for professional teachers and teaching. Professional teachers require professional development.

Concurrent with this call for more professional development has been a call for more research on teacher learning. Yet, what the field "knows" about teacher learning is rather puzzling. In part, this is due to the scattered and serendipitous nature of teachers' learning. Beginning teachers take methods and foundations courses in education departments and subject matter courses in discipline departments. Sometimes they work in the field, sometimes in the university. And every school experience, whether it be in elementary or middle or high school, in a college or university, has the potential for teaching them lessons about what school is, what teachers do, and how people learn. Lortie's [1975] characterization of this curriculum as the "apprenticeship of observation" has been a major

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influence in attempts to theorize about what prospective teachers "know" about teaching before they enter the profession.

Practicing teachers participate in mandatory part-day or day-long workshops sponsored by their school district. They pursue individual learning opportunities: enrolling in master's courses, signing up for summer and weekend workshops, joining professional organizations. Some learning, no doubt, goes on in the interstices of the workday, in conversations with colleagues, passing glimpses of another teacher's classroom on the way to the photocopying machine, tips swapped in the coffee lounge, not to mention the daily experience of the classroom. While workshop opportunities have been criticized for being decontextualized and contrived, Lord (1994) notes that these other opportunities for teacher learning (while they may be more authentic) are happenstance, random, and unpredictable. In sum, teacher learning has traditionally been a patchwork of opportunities—formal and informal, mandatory and voluntary, serendipitous and planned—stitched together into a fragmented and incoherent "curriculum" (Ball & Cohen, in press).

As a field, we know very little about what teachers learn across those multiple opportunities. Teacher lore suggests that traditional in-service programs consist of outside experts with little knowledge of local conditions who present irrelevant, sometimes amusing, often boring prepackaged information (Corcoran, 1995; Little, 1989, 1994). Teacher lore goes on to argue that these experiences are irrelevant and teach teachers little (or at least little of worth). In his survey of teachers' ratings of opportunities to learn, Smylie (1989), for example, found that district-sponsored in-service workshops were on the bottom of the heap, ranked last out of 14 possibilities in terms of what teachers considered most valuable. Although most workshops are accompanied by evaluations—typically consisting of filling out a form about what was enjoyable—efforts to measure what teachers learned have not been part of typical evaluation fare. And while Smylie found that teachers ranked direct classroom experience as their most important site for learning, extensive studies of teacher learning through practice have not yet been conducted. Action research, in which teachers document and analyze their own experiences, can be seen as one important attempt to redress this problem.

Hence, across this incoherent and cobbled-together nonsystem, structured and unstructured, formal and informal, we have little sense—save the collective and negative self-reports of generations of teachers about traditional in-service programs (Gall & Renchler, 1985; Guskey, n.d.; Showers, Joyce, & Bennett, 1987)—of what exactly it is that teachers learn and by what mechanisms that learning takes place. What knowledge do teachers acquire across these experiences? How does that knowledge improve their practice? These questions are left unanswered.

CONTEMPORARY BELIEFS ABOUT EFFECTIVE PROFESSIONAL DEVELOPMENT

Despite the lack of substantial empirical evidence about what teachers learn (or do not learn) in traditional professional development activities, many educators

have embraced the calls for a wholesale rejection of the traditional, replacing the old with new images of meaningful professional development. Principles for designing such work abound in the current literature. Little (1988) nominates the following features of effective staff development: (a) It ensures collaboration adequate to produce shared understanding, shared investment, thoughtful development, and a fair, rigorous test of selected ideas; (b) it requires collective participation in training and implementation; (c) it is focused on crucial problems of curriculum and instruction; (d) it is conducted often enough and long enough to ensure progressive gains in knowledge, skill, and confidence; and (e) it is congruent with and contributes to professional habits and norms of collegiality and experimentation.

Abdal-Haqq (1995, p. 1) nominates a similar set of characteristics, claiming that effective professional development

1. Is ongoing.
2. Includes training, practice, and feedback; opportunities for individual reflection and group inquiry into practice; and coaching or other follow-up procedures.
3. Is school based and embedded in teacher work.
4. Is collaborative, providing opportunities for teachers to interact with peers.
5. Focuses on student learning, which should, in part, guide assessment of its effectiveness.
6. Encourages and supports school-based and teacher initiatives.
7. Is rooted in the knowledge base for teaching.
8. Incorporates constructivist approaches to teaching and learning.
9. Recognizes teachers as professionals and adult learners.
10. Provides adequate time and follow-up support.
11. Is accessible and inclusive.

In her review of contemporary rhetoric on professional development, Ball (1994, 1996) notes a handful of prevalent "beliefs." For example, she notes that scholars currently believe that teachers' prior experience, knowledge, and beliefs factor into teacher learning:

What teachers bring to the process of learning to teach affects what they learn. Increasingly, teachers' own personal and professional histories are thought to play an important role in determining what they learn from professional development opportunities. (Ball, 1996, p. 501)

Ball goes on to argue that current rhetoric about professional development also pays close attention to the students for whom and the contexts in which teaching takes place: "The contexts in which teachers work are believed to affect what they can do." Time, reflection, and follow-up are also thought to be important: "The most effective professional development model is thought to involve follow-up activities, usually in the form of long-term support, coaching in teachers' classrooms, or ongoing interactions with colleagues" (Ball, 1996, pp. 501–502).

Other prevalent beliefs include the idea that "teacher educators and staff developers should model the approaches that they are promoting" and that teachers need to own and control their professional development:

Teacher development is considered especially productive when teachers are in charge of the agenda and determine the focus and nature of the programming offered. In the name of professional autonomy, many argue that teachers should determine the shape and course of their own development. (Ball, 1996, p. 502)

Noting the consistency across such lists, Putnam and Borko (1997) reduce the list to four essential "mantras" or "truisms":

1. Teachers should be treated as active learners who construct their own understanding.
2. Teachers should be empowered and treated as professionals.
3. Teacher education must be situated in classroom practice.
4. Teacher educators should treat teachers as they expect teachers to treat students.

These principles and beliefs seem reasonable. Yet, we know as little about what teachers learn in these kinds of forums as we do about what teachers learn in traditional staff development and in-service. Our readiness to embrace these new principles may, in fact, be rooted in a desire to escape collective bad memories of drab professional development workshops rather than in sound empirical work. But replacing our old conceptions of professional development with new makes sense only if the new ideas are held up for rigorous discussion and evaluation. New is not always right.

If preliminary examinations of these lists yield less than compelling evidence in their support, it seems logical to delve deeper into relevant research to investigate the following: What do we *know* about teacher learning? Specifically, what do we know about the *professional knowledge* teachers acquire in such experiences? To narrow our focus here, we examine the learning of practicing (not preservice) teachers. Readers interested in reviews of the literature of preservice teacher learning might examine the recent thoughtful and comprehensive work of Putnam and Borko (Borko & Putnam, 1996; Putnam & Borko, 1997), as well as that of Feiman-Nemser and her colleagues (Feiman-Nemser, 1983; Feiman-Nemser & Buchmann, 1985; Feiman-Nemser & Floden, 1986; Feiman-Nemser & Remillard, 1995).

We began our task by reading widely. Our selection was guided by three principles. First, we opted to focus on high-quality examples of professional development and elicited nominations of thoughtful work. We stipulated that each nomination had to consist of a professional development project that also had a clear commitment to conducting research. Second, as Elmore, Peterson, and McCarthy (1996) claim, understanding teacher learning includes attending to both the curriculum and the pedagogy of professional development, to *what* teachers learn and *how* teachers are taught. Thus, we selected professional development projects in which staff thought about both the what and how of teacher

learning. And third, following this principle, we acknowledged that professional teaching knowledge might include, at the very least, knowledge of subject matter, of individual students, of cultural differences across groups of students, of learning, and of pedagogy (Ball & Cohen, in press; Shulman, 1986, 1987).

With these three principles in mind, the research we collected loosely fell into three "knowledge" categories: (a) opportunities to talk about (and "do") subject matter, (b) opportunities to talk about students and learning, and (c) opportunities to talk about teaching. Rather than exhaustively review literature relevant to each domain, we opted for an alternative route, describing two exemplary instances within each of these categories with an eye toward what they teach us about the acquisition of professional knowledge.

ALTERNATIVE APPROACHES TO TEACHER LEARNING OF PROFESSIONAL KNOWLEDGE

Opportunities to Talk About Subject Matter

In the Cheche Konnen Project ("search for knowledge" in Haitian Creole), Rosebery and her colleagues at TERC in Cambridge, Massachusetts (Rosebery & Ogonowski, 1996; Rosebery & Puttick, in press; Rosebery & Warren, 1998a, 1998b), have been working collaboratively with bilingual, English-as-a-second-language, and science teachers to explore how to create classroom communities of scientific practice. In Cheche Konnen, science learning is organized around students' own questions. Students pose questions, design studies, and conduct inquiries. They collect and analyze data, make conjectures, and prove (or disprove) hypotheses. The researchers found that, over the study year, students' talk changed dramatically, their scientific thinking deepened, and they knew much more about the specific topics they studied.

As a set of parallel experiences, the TERC researchers have engaged the participating teachers in a series of professional development activities. At first, the researchers used a traditional model: They invited four teachers to a summer workshop that lasted for several days, during which time the teachers were "walked through" the new curriculum. In the following year, teachers did not enact the curriculum in ways intended. And as the researchers investigated the reasons why, they discovered that the teachers had not changed their beliefs about science or science teaching, even though they had agreed to teach a radically different science curriculum. Teachers had acquired a new curriculum, a new set of teaching moves and materials, but no new knowledge about science or the teaching of science. These new curricula, when filtered through and shaped by old beliefs, turned into something more traditional than not. As Franke, Carpenter, Levi, and Fennema (1998) learned, "Engaging teachers in current reforms requires more than showing them how to implement effective practices" (p. 1).

The following summer, the researchers designed a different form of professional development. They aimed to create—among the teachers—a scientific community. The group met every other week for 2 hours after school and for 2

weeks in the summer. The seminar involved the teachers in "doing science": Teachers engaged in investigations, pursuing their questions at home and in the seminar. In the context of that work, teachers learned to "sound scientific": They struggled to adopt a scientific discourse and to own the concepts, ideas, and inquiries. The teachers worked as a community, socially constructing their understandings of snails and ecology. Over time, they began to bring their own teaching to the table for discussion and critique. The researchers note the connection between teacher learning and student learning:

We believe that the remaking of science education into a more egalitarian sense-making practice entails deep transformations of identity for teachers and students alike, transformations that empower them to think, talk, and act scientifically. (Warren & Rosebery, 1995, p. 42)

In subsequent research, Rosebery and her colleagues began searching for research methods that enabled the documentation and analysis of what teachers were learning. In one such analysis, Rosebery and Warren (1998b) look at the discourse of the group. They propose that members with different backgrounds and expertise (teachers and biologists, say) bring different discourses to the effort and that part of the group's work involves establishing shared meanings. Because the group works together over time, these shared meanings themselves are not static but ever changing:

The construction of a shared meaning does not happen in an orderly, linear progression, from implicit to explicit meaning. Rather, it has a more mobile, mutable, improvisational character as meanings are taken up and elaborated by different participants, each of whom draws on past as well as "already accepted" perspectives in the conversation. In this way, the meaning of "hypothesis," "experiment," and "control" are in motion for all the participants—researchers as well as teachers—as they work to formulate a shared understanding. (pp. 10–11)

The researchers' analysis of the group's discourse raises several significant issues about teachers' acquisition of professional knowledge. First, they note that what is learned goes well beyond words:

This stretch of talk seems to us a good example of how learning scientific meanings for particular words is not a matter of learning at the level of the words themselves but at the level of the discourse or the practice. The sense or resonance that the word "hypothesis" has is strongly a function of the contexts of its use, of the practices of which it is a part, which crucially also involve other stances or views of the world, for example, what it means to do an experiment, what it means to explain a particular behavior, what is involved in stating a hypothesis, how hypotheses function in different forms of scientific inquiry such as observation and experimentation. (Rosebery & Warren, 1998b, p. 13)

These researchers are grappling with ways to capture "knowledge" that transcend words on paper. The participants' "knowledge" of "experiment," "hypothesis," and the like appeared to change as they engaged in the scientific process. And while their "knowledge of science" could be captured in the ways they define terms, the researchers have a hunch that some significant aspects of that knowledge go beyond paper. They use the language of "stance" and "resonance" to capture something of the quality of the teachers' developing knowledge, for knowledge goes well beyond words readily recited at a spelling

bee or oral examination. Knowledge entails skills, ways of talking and interacting, ways of observing and noticing things in the environment, and dispositions toward action and interpretation. The researchers noticed teachers learning things that went well beyond their capacity to define terms. But capturing that knowledge has proved difficult.

The researchers also found that the group developed a set of "canonical stories" that served as the coin of their conversational realm. Participants developed a shorthand that took the form of cases—"Jimmy's problem," "the giraffe's neck," "pepper moths"—that meant something to them but remain obscure to those of us not present. Other such cases have recently appeared in the larger national discourse on teaching and learning; Cohen's (1990) "Mrs. O." and Ball's (1993) "Shea numbers" are but two examples. That teachers' knowledge might be held in the form of such stories or cases is a hypothesis that Lee Shulman (1986) proposed, and it might well be that one way of measuring teacher knowledge within these communities would involve documenting and assessing what these stories were and what meaning they held for the teachers. Indeed, an entire line of teacher development work has arisen in the wake of that observation, with educators using developed cases to teach teachers (e.g., Shulman, 1992) and teachers writing their own cases as a means for professional development (Barnett, 1991, 1998; Barnett, Goldenstein, & Jackson, 1994; Schifter, 1996a, 1996b; Shulman, 1992; Shulman, Lotan, & Whitcomb, 1998). While such cases are meant to be disseminated and shared, the knowledge that appears in these professional development communities suggests that "case knowledge" has validity (it naturally arises in these communities of learning teachers) and potential as a research tool or site for measuring teacher knowledge.

Grossman and Wineburg (Grossman, Wineburg, & Woolworth, 1998; Thomas, Wineburg, Grossman, Myhre, & Woolworth, 1998; Wineburg & Grossman, 1998, in press) created a different model for engaging teachers with subject matter, this time in the form of a book club. In a 3-year project funded by the McDonnell Foundation, Grossman and Wineburg met monthly with a group of English and social studies teachers (the group also consisted of a smattering of student teachers, special education teachers, and English-as-a-second-language teachers). The group selected, read, and discussed fiction and history, using their discussions to create a community of teacher-learners who could then develop an integrated English–social studies curriculum. The group read broadly: Nathan McCall's *Makes You Want to Holler*, Christopher Browning's *Ordinary Men*, Robert Olin Butler's *Good Scent from a Strange Mountain*, Rian Malan's *My Traitor's Heart*, Doris Kearns Goodwin's *No Ordinary Time*.

Eventually, the group became a "community of readers." Wineburg and Grossman (in press) saw the process as enabling:

The act of reading together in a community of learners has made epistemology visible, and the act of surfacing and naming assumptions has created the conditions for self-awareness and inter-subjectivity. We don't necessarily agree any more than we did before, but our disagreements are richer and more productive. Instead of being treated as instances of individual intransigence, our discussions

of different ways of reading are now understood as reasoned and legitimate differences from which we can all learn.

While they created and participated in this group, Grossman and Wineburg also conducted research. Their research questions included: What is intellectual community among teachers? How does it develop (or not develop)? How does the development of intellectual community enable teacher learning? How do teachers learn from one another? Along the way, they collected field notes; conducted individual participant interviews; used free writes, group surveys, and evaluations; and taped the group discussions. The researchers also collected data on teachers' knowledge. They had teachers read and think aloud in interviews, as well as participate in four sets of interviews that included repeated measures of teachers' professional knowledge. However, the researchers are in the midst of conducting analyses of these data, so the review here describes only the results that have already emerged, not the potential for additional results on the horizon.

Using a system of discourse analysis that they adapted to be subject matter specific, the researchers documented differences in individuals' participation. They found evidence that some teachers learned to contribute in different ways to the group discussions and that some learned to think differently about the nature of history and literature (and their relationships and differences). Over time, group members began to realize that history and English teachers read quite differently, attending to issues of warrant and evidence differently, reacting to students making personal connections to the texts differently. For instance, in history, the fact that students sometimes assume that their world view and values are identical to those of individuals from the past (called "presentism") is a problem. Assumptions of similar valuing and perspective made it difficult for students to understand actions in the past, actions predicated on and motivated by different assumptions and values. Yet, the very same "problem" in an English class can enhance reading, for putting oneself inside the experience of a character can deepen one's reading. Participants eventually learned to notice—and value—these substantive differences rather than dismissing them as merely "personality" clashes.

But what of changes in classroom practice? According to teachers' self-reports, teachers tried to create similar discussions among their students, modeled their own thinking for students, and learned to listen for differences in students' interpretations. The researchers noted some unforeseen consequences:

We also did not anticipate some of the effects our project has had on students, who see their teachers leave the classroom once a month to model what it means to be lifelong learners. Students spy copies of the project books on their teachers' desks and then hear different versions—sometimes opposing versions—of these books from different teachers. More than once our books have ended up as the subject of student book reports or even as part of the regular curriculum. When an English teacher reminded students that they were to provide a "critical evaluation," not a piece of fan mail, for their book reports, one student teased her, "Just like you Ms T, with your books for the McDonnell Project!" (Wineburg & Grossman, 1998, p. 353)

Stories such as these are both intriguing and hopeful, but the researchers acknowledge that the link to practice is the weakest one in their project (Grossman, Wineburg, & Woolworth, 1998).

Thoughtfully and carefully constructed, these professional development opportunities had meaning for participants. As we examine other forums for professional development, the patterns that begin to emerge here will echo in other research: that teachers enjoy the chance to talk about their work, that it takes time to develop a community, that teachers have very little experience engaging in a professional discourse that is public and critical of their work and the work of their colleagues. Other issues remain less clear at this point: What exactly are these teachers learning? What science do they know, or history? What kinds of knowledge and skill are they acquiring? How do researchers document that knowledge? And how is that knowledge affecting their practice? Do these groups support teachers or teaching? Is this distinction important? These are questions that haunt researchers, and we return to them later in the cross case analysis of different forms of professional development. For now, however, we turn to our next "case": teacher learning opportunities that focus teachers' attention on students and learning.

Opportunities to Talk About Students and Learning

Our second case of teacher learning involves professional development programs that have as their focus students' thinking. The first instance of such professional development is Cognitively Guided Instruction (CGI) (Carpenter, Fennema, & Franke, 1996; Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Fennema et al., 1996; Fennema & Franke, 1992; Fennema, Franke, Carpenter, & Carey, 1993; Franke, Carpenter, Levi, & Fennema, 1998; Peterson, Carpenter, & Fennema, 1989). Carpenter, Fennema, Peterson, and Carey (1988) found that teachers' knowledge of children's thinking tended to be informal and lacking in organization or coherence. These researchers then designed a professional development project that provided teachers with a classification of addition and subtraction problems and descriptions of variations in students' thinking around those problems. Subsequent generations of CGI included information about students' thinking in regard to other mathematics areas as well (Fennema, Franke, Carpenter, & Carey, 1993).

Participants learned about a framework of children's thinking, as well as about particular mathematics problems and the patterns of children's thought about those problems. Thus, teachers might leave CGI discussions with more "theoretical" knowledge of the characteristics and development of children's thinking and "particular" knowledge of problems. No prescriptions about the implications for practice were made, and teachers made their own decisions about how to use their knowledge of student thinking in their teaching.

A series of studies have investigated the impact of CGI on teachers and students. In one analysis, Carpenter, Franke, and Levi (1998) contrasted two teachers: Ms. Sanford and Ms. Cole. Ms. Sanford had learned many things from CGI, ranging from "big ideas" (e.g., that children construct their understandings) to specific strategies that children typically invent when learning to add and subtract multidigit numbers. Ms. Sanford saw her own learning in ways similar

to her views of children's learning: She built her professional knowledge through experience and reflection, some of which took place out of school, most of which happened in her own classroom. Ms. Sanford left CGI with a framework for continuing her own investigations into students' thinking. And she saw that as part of her practice.

Ms. Cole learned about constructivism. She reported that CGI helped her learn how important it was to listen to children. When asked how she would continue to learn more things, Ms. Cole talked of taking more classes and rereading articles from past classes. She did not view her own teaching as a site for her continued professional development. Rather, professional knowledge was a fixed body of information that could be packaged and delivered in courses and experiences outside of classrooms. And her job, as a teacher, was to take that newly acquired knowledge and weave it into her practice.

Carpenter, Franke, and Levi (1998) note the complex interdependence of a teacher's beliefs and teaching and how beliefs shape future learning opportunities:

> Ms. Sanford believed that she would learn from her students, and her classroom practices provide a context for her learning. Ms. Cole did not perceive her classroom as a place for her own learning about student thinking, and her class interactions provided relatively little opportunity for such learning. It is not clear whether teachers construct classrooms in which they can learn from students because of their beliefs about engaging in practical inquiry to better understand student thinking or whether their beliefs come from interacting and learning from their students. We suspect it is not all one way or the other. (pp. 12–13)

In another analysis, Franke, Carpenter, Levi, and Fennema (1998) observed and interviewed 22 teachers who had participated in a later version of CGI consisting of summer workshops and 2 years of field support. The researchers found that teachers—4 years later—were at different levels of development. Based on their research, they proposed four levels of teacher development.

Level 1:   A teacher at Level 1 does not believe that the students in his or her classroom can solve problems unless they have been taught how.

Level 2:   At Level 2, a shift occurs as the teacher begins to view children as bringing mathematical knowledge to learning situations.

Level 3:   The teacher at Level 3 believes it is beneficial for children to solve problems on their own because their own ways make more sense to them and the teacher wants them to understand what they are doing.

Level 4A: The teacher at Level 4A believes that children's mathematical thinking should determine the evolution of the curriculum and the ways in which the teacher interacts individually with students.

Level 4B: The teacher at Level 4B knows how the knowledge of an individual child fits in with how the child's mathematical understanding develops (Franke, Carpenter, Levi, & Fennema, 1998).

Using interviews and observations, the researchers categorized 10 of their 22 informant-teachers as being at Level 4B, 2 as being at Level 4A, 4 as being at Level 3, 6 as being at Level 2, and 1 as being at Level 1. Teachers who had reached Level 3 showed the most instability, 4 moved to Level 2 while 4 stayed

at Level 3. Teachers who were at Level 4A or 4B stayed at that level with the exception of 1 Level 4B teacher who became more of a Level 3 teacher. The researchers found that while all 22 teachers reported that children's thinking was a significant part of the way they thought about instruction, the teachers varied in both the level of detail of their knowledge of children's thinking and how much emphasis they placed on children's thinking in their teaching.

Another observable difference in the teachers was the extent to which they conceptualized CGI-related knowledge as a theoretical framework or as a set of problem types. Level 3 teachers recognized that there were different problem types and used those problems in their teaching. They imported the CGI problems into their practice, modifying their practice somewhat to accommodate for more listening to students. Teachers at Levels 4A and 4B put more emphasis on CGI's conceptual framework, placing the illustrative problem types within that overarching structure. Within the larger frame, they continued to acquire and organize a great deal of specific knowledge about children. Level 3 teachers did not:

The Level 3 teachers focused on children's abilities to solve problems in a variety of ways. They valued the children's solutions, not in terms of the specific strategy the child used but rather in terms of having the children use and share different strategies. . . . Often Level 3 teachers could not explain their students' thinking. At times they told us that they were not sure what a given student had done; other times they made general inferences about why a child had difficulty with a problem that they could not support with specific detail. (Franke, Carpenter, Levi, & Fennema, 1998, p. 15)

The researchers also detected differences in teachers' perceptions of their role vis-à-vis the development of knowledge of children's thinking. Teachers at Level 4B thought that it was both within their power and their responsibility to develop knowledge of student thinking. While the CGI research had launched them on the path of learning about children's mathematical thinking, these teachers saw their practice as a site for further inquiry—this time, their own. They were constantly testing that knowledge and engaging in practical inquiry. Teachers at Level 4A and below did not talk about learning more about children's thinking on their own. As the researchers note, "Teachers at Level 3 and Level 4A think the knowledge is critical and it is central in how they think about their teaching, but they see the knowledge as something passed on to them" (p. 19).

The researchers also found that every teacher talked of the need for community. For some, the communities were within their schools; for others, the boundaries of the community transcended school walls. In every case of teacher ongoing learning, however, teachers were engaged in learning communities that allowed them to test, discuss, revise, and retry their ideas about children's mathematical thinking and its relationship to instruction. The teacher communities had two significant features: They were self-sustaining, and the work of the group focused on students' thinking. The researchers described the change they witnessed in some teachers as "generative" as well as "self-sustaining":

We are not proposing that children's thinking is the only avenue for teacher's growth to become generative; however, it has characteristics that provide a basis for generative growth. Children's

thinking is available to teachers in their classrooms daily. There are regularities among the strategies that children describe and principled ideas can be ascertained about these regularities. Teachers can create a way to talk with each other about both their classrooms and their students. Teachers can create communities of learning that focus on children's thinking: how their children are thinking about the mathematics, what it might mean, how they can learn more about their children's thinking and the ways they can provide opportunities for students to build on their thinking. The learning communities these teachers create include their classrooms. These communities provide a basis for teachers to engage in inquiry focused on children's mathematical thinking with their students, their colleagues, and themselves. (Franke, Carpenter, Levi, & Fennema, 1998, p. 23)

In addition to interview and observational data, CGI researchers collected data on student achievement, teacher beliefs, and teacher knowledge. Thus, researchers were able to measure and characterize teacher learning as well as student learning. The researchers found that teachers who participated in CGI taught problem solving significantly more and taught number facts and skills significantly less. The teachers used different instructional strategies, listened to students more, and believed that instruction would build on what students know. Analyses of student achievement showed that students of CGI teachers recalled number facts at a higher level, as well as exceeding students in control classrooms in problem solving and confidence (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989; Fennema, Franke, Carpenter, & Carey, 1993).

Our second case of professional development that aims to engage teachers in thinking about students is very different from CGI's research-based model. The Future Teachers' Autobiography Club started as a small group of prospective teachers who met regularly with Susan Florio Ruane to read autobiographies. The group eventually grew into a professional development community for practicing teachers, and we include this case as a stimulus for considering the potential relationships between preservice teacher education and ongoing professional development.

Florio Ruane (1994) conceived the autobiography club as a way to help prospective literacy teachers learn to think about culture, language, experience, and schooling. Noting that the majority of the teaching force remains White and female and that literacy is "neither a monolithic phenomenon nor a collection of technical skills" but, rather, "a social accomplishment" highly influenced by culture and context, Florio Ruane designed the autobiography club as a means for teaching teachers about literacy and diversity, assuming that Zeichner (1993) was correct when he claimed that teacher candidates need to acquire "the desire and ability . . . to learn about the special circumstances of their own students and communities and the ability to take this kind of knowledge into account in their teaching" (p. 6).

Florio Ruane's initial goal was to help these prospective teachers "approach the teaching of literacy inside school with greater insight, imagination, and sensitivity" by having them read—and then discuss—a half a dozen autobiographies focused on literacy, including *Lost in Translation* by Eva Hoffman, Maya Angelou's *I Know Why the Caged Bird Sings*, *The Hunger of Memory* by Richard Rodriquez, and Jill Ker Conway's *The Road from Coorain*.

Six university seniors volunteered to become club members. They agreed to meet for 6 months and read six books that Florio Ruane selected. Meetings took place over dinners in her home, outside the university's institutional walls. Florio Ruane was participant and observer, collecting field notes and audiotaping conversations. Participants also wrote in "sketchbooks" and participated in interviews. There was no teacher—as such—and the group was collectively responsible for managing the discussions.

In an early report on the club's activities, Florio Ruane (1994) reported that the club became a forum for talking about books and about the teachers' lives. In a discussion of *I Know Why the Caged Bird Sings*, readers offered their own stories of personal revelation upon graduation. Their stories focused on themes including educational equality, constraints on choice, and the search for identity. Because six students shared their very different personal stories, the participants had the chance to see how there was variation even in their small group, not to mention among their own students. Florio Ruane also noted that the discussions were more like ordinary conversations than school talk:

The Club members seem to monitor other speakers very closely, keeping track of what is being discussed and what the point of it is, in part for the purpose of turn exchange. Participation is high and marked by such involvement strategies as overlapping speech, humor, personal narrative, and repetition of key words and images across turns and speakers. (p. 62)

As she analyzed their talk, Florio Ruane (1994) observed that teachers drew on several kinds of knowledge: personal or autobiographical knowledge (what happened in my school), knowledge of the book, and knowledge of other texts (books, newspapers, movies). Teachers drew most heavily on the autobiographical knowledge, rarely discussing the book directly. As Florio Ruane notes: "They seem instead to narrate personal experiences moving near to or playing upon tacitly held notions of the book's themes but, like jazz musicians playing individual variations on a well-known tune, rarely touching it directly" (p. 64).

In subsequent analyses, Florio Ruane and Julie deTar (1995) discovered that discussing autobiography is not a "benign affair." Discussions, while remaining polite and respectful, were nevertheless uncomfortable at times, requiring that the teachers take risks. Teachers did not always agree, and although wanting to respect each other's opinion, they needed also to disagree and critique peers' positions. Merging argument with conversation was no easy matter for the group, yet talking about volatile issues—equity and equality, racism—required doing just that.

As a site for research on teacher learning, these conversations offer challenges. Peer discussion and personal narrative, while appealing, are "complicated means to not well-specified ends":

Conversation is a messy, indeterminate medium for growth. Educators believe it is necessary for rich and complex thinking, yet it is hard for them to handle and even harder for researchers to understand. Thus our preference for learning that is rooted in conversation quickly outstrips our

understanding of the medium and finds our ordinary methods of inquiry challenged by its variety and complexity. (Florio Ruane & deTar, 1995, p. 36)

In subsequent work, Florio Ruane has collaborated with a number of colleagues in the design and development of a master's level course in literacy that involved reading autobiographies. At the request of the students at the course's end, Florio Ruane, Raphael, Glazier, McVee, and Wallace (in press) created the Literary Circle, a voluntary book club that continues meeting and reading. As the researchers analyzed the group's interactions, their results were similar to Florio Ruane's experience with the autobiography club: Early discussions were more like "fishing expeditions" than conversations, and it took time to develop the trust and discourse norms that would enable sustained discussion. Even then, though, the group tended to avoid difficult discussions, for instance, those about race. Furthermore, discussions could appear to be personally connected while participants were nevertheless maintaining distance between themselves and the topic, group, or book. The researchers concluded that perhaps the most powerful aspect of group participation was that it enabled the development of an "intellectual identity" for the participants.

As we consider the research on teachers' learning about subject matter and teachers' learning about students, two things seem clear. Teachers enjoy talking about materials relevant to their work, be that subject matter or theories of student learning. Teachers embrace these opportunities to be intellectuals. Yet, they bring little by way of experience to professional conversations. The norms of school have taught them to be polite and nonjudgmental, and the privacy of teaching has obstructed the development of a critical dialogue about practice and ideas. Each research project finds itself struggling to support the development of such a culture.

The research also shows how difficult it is to capture teacher learning in these contexts. CGI researchers had a framework of children's thinking, and they were able to assess whether individual teachers had acquired knowledge of that framework. In the other projects, it is less clear how teacher learning would best be assessed. Are teachers to know the plot lines and characters of the books they are reading in book clubs? Are they to understand cells and their structure as they learn science? As professional development projects engage teachers in learning the subject matter, researchers need to think about the knowledge they hope teachers will acquire through these learning opportunities. While teachers may learn many additional things, stipulating a clear set of expectations for teacher learning might enable more research on the acquisition of professional knowledge.

In addition, the location of the knowledge is also unclear. As communities grow, they develop a shared knowledge, knowledge that both transcends and shapes the knowledge of individual participants. As researchers investigate teacher learning within these contexts, they struggle with how and when to capture group knowledge versus an individual's knowledge. The fact that communities, as well as individuals, acquire knowledge has implications for crafting and assessing

all professional development. Consider the differences between school-based professional development and opportunities to learn that are offered outside of the school setting. School-based professional development activities develop shared knowledge and norms that directly translate into school capacity. On the other hand, it might be easier for teachers to reveal what they do not know (so that they might learn more) in contexts away from their home schools. Yet, what they learn in those other communities might not be easily transported into a school where their willingness to learn and experiment is neither understood nor supported. These issues and others will continue to challenge researchers interested in teachers' acquisition of professional knowledge. We turn now to our third case: opportunities to talk about teaching.

Opportunities to Talk About Teaching

Clearly, our categories are not discrete, since the conversations these communities of teacher-learners engage in shift easily and sensibly from talk of books to talk of how to teach the books, from talk of students to talk of how to teach those students. Our first instance of opportunities for talking about teaching highlights this quality of shifting focus: It began as a group that would discuss teaching, only to decide that—in order to understand teaching—the members first needed more knowledge of mathematics.

The Investigating Mathematics Teaching group (IMT) is a collection of seven elementary and middle school teachers and three university teacher educators at Michigan State University who have been meeting weekly since 1991 to discuss issues related to mathematics teaching (Featherstone, Pfeiffer, & Smith, 1993; Featherstone et al., n.d.; Featherstone, Smith, Beasley, Corbin, & Shank, 1995; Pfeiffer & Featherstone, n.d.; Smith & Featherstone, n.d.). During their first semester together, the group members watched and discussed videotapes and other materials associated with Deborah Ball's teaching of third graders (cf. Lampert & Ball, 1998). After the fall term, they agreed to continue meeting, but they did not want to watch tapes. Their reasons are intriguing in light of our interest in understanding teachers' acquisition of professional knowledge:

These teachers have said subsequently that they did not understand operations involving negative numbers well enough to understand the conversations of the third graders, and that watching these videotapes made them feel stupid. (Pfeiffer & Featherstone, n.d., p. 7)

The group then began discussing their own teaching, integrating talk of their classroom practices into talk of the curriculum and evaluation standards of the National Council of Teachers of Mathematics (NCTM; 1989, 1991). At the end of the school year, the group expressed an interest in continuing in the following school year. But they wanted to begin before the school year started so that they could get some help in thinking about how to socialize their students at the beginning of the year into issues associated with ''doing math.''

One of these sessions turned into an activity that asked teachers to work through problems designed to challenge their math skills. Throughout their work,

the teachers kept track of their thoughts and reflections in journals. They recorded, for example, their frustrations with doing the problems, sometimes feeling panic when others were writing away. Using their experiences as learners, the teachers began thinking about their students and their teaching practice. "How do third graders feel when they don't get it?" the teachers began to wonder.

According to participants' self-reports, the group served several functions, not all of them involving the acquisition of professional knowledge; doing math problems and noticing how they felt, teachers began thinking about how students felt in similar circumstances. One participant just needed to be part of a group so that she could hold on to her commitment to learning and changing her practice. Having recently had a baby, she had no time to work on her practice. But every week she drove 140 miles to be a silent partner in the group's delibera-tions because she was afraid—literally—to lose sight of those who were. She needed to maintain the connection, reporting that she was afraid that letting those teachers who were struggling out of her sight would cause her to forget "what it looks like" to learn and change.

In one analysis of the group's interactions over time, Pfeiffer and Feather-stone (n.d.) examined changes in the group's discourse. IMT members listened to tapes of previous discussions, observing shifts in their norms. Several noted that a feature of the group's discussions had become "pushing each other." As one teacher noted, "Whew, we're playing hardball, now" (p. 10). Using the work of sociolinguists such as Tannen (1989) and Gumperz (1982), the researchers analyzed participants' "conversational involvement" and found three characteristics.

First, the conversations became more sustained and focused. For example, the number of topic changes drastically changed over time. In October of 1991, there were 37 topic changes in one evening's conversation; during the following September and October, the topic changes hovered in the range between 3 and 12. Second, the talk was "passionate":

> The teachers sounded emotional and animated as they described their experiences and the realities they confront daily. Their stories included strong expressions of uncertainty and frustration about how to enact the vision to which they were now personally and professionally committed. They described their concerns as pressing. (p. 18)

Third, the researchers found that the discussions exhibited an increased amount of public disclosure. When teachers began meeting, their concerns for presenting themselves as competent professionals appeared to compromise their capacity to share their problems. For teachers, who work within contexts where parents, administrators, other teachers, and students expect them to be the authority, admitting that one's practice is less than perfect is an act of vulnerability that depends on group trust and mutual respect. Trust and respect, in a profession beleaguered by consistent criticism, take time to develop.

A fourth feature was dependent on these three previous ones: the emergence of public disagreement. As the IMT teachers' conversations became longer and

more sustained, focused, disclosing, and passionate, public disagreements began to emerge.

What were teachers learning in this group? It would appear that the group was developing a set of norms that allowed for professional discourse, for talk that would push thinking, perhaps even push practice. In several instances, there is evidence that teachers were learning to rethink their arguments and to evaluate their assumptions. Several participants were actively experimenting with their teaching. The authors also claim that the IMT members were learning about the enactment of mathematics reforms by engaging in their own learning in similar ways.

Our second case of opportunities to talk about teaching looks quite different and involves a qualitatively different forum: the professional network. Professional networks for teachers have gained substantial popularity in the last 15 years (Lieberman & McLaughlin, 1992; Pennell & Firestone, 1996). As they multiply, they take many forms, with no one network offering exactly the same opportunities to educators as another.

In one study of networks, Pennell and Firestone (1996) contrast the California Subject Matter Projects with the Vermont portfolio program. They interviewed teachers and teacher-leaders statewide and conducted case studies of particular sites within each of these networks. Each network envisioned accomplished teaching in similar ways: Teachers would be facilitators and guides, students would engage in real-world problems, working would be meaningful and purposeful, skills would be embedded in large problem-solving activities, students would often work collaboratively, and assessments would be ongoing and authentic. Each network also had a commitment to a "teachers-teaching-teachers" model of professional development (Pennell & Firestone, 1996, p. 53).

The researchers found that teachers' beliefs and background, social influences, and practical circumstances all shaped teachers' reactions to their experiences within the networks. As Pennell and Firestone (1996) note:

The California and Vermont network programs were most effective when teachers held beliefs that did not strongly conflict with program philosophies, some social support existed for participation and classroom change, and practical circumstances were not heavily prohibitive of participation and change. (p. 72)

It is difficult to ascertain what teachers were learning in this study, since the researchers had to rely on evaluation feedback about participants' feelings regarding networks. Such data are constraining; respondents to surveys and evaluations seldom report on what they learned but, rather, on what they thought of the enterprise.

In another study, one involving 16 educational reform networks, Lieberman and Grolnick (1996) found that the networks, while varied, shared five organizational themes. The first theme concerned the fact that each network had a purpose and direction, a goal, a cause, an interest around which the groups coalesced. For some, the goal might be the development of professional development schools;

for others, it might be the pursuit of helping schools become democratic organizations.

A second organizational theme concerned important qualitative features of the network communities. Each network was built and sustained by a constantly growing and developing community in which individuals had voice and commitment to the group, learned to collaborate, and strove for consensus. Each network entailed bringing people together for conversations; in these conversations, participants both learned and received emotional and psychological support.

A third theme that Lieberman and Grolnick noted was that each network used a range of activities to engage participants in learning and discussions. The activities varied: Electronic networking, conferences, courses and institutes, workshops, teacher research teams, and formal and informal study groups appeared across the networks. Characteristic of these activities was "time to talk." This time enabled the development of relationships that lasted long after the meeting or institute was over.

The fourth theme concerned the facilitative leadership that was essential to these networks.

At times, facilitating networks appears to be about making phone calls, raising money, establishing connections, forming groups, finding places to meet, and brokering resources and people. However, it is also about creating "public spaces" in which educators can work together in ways that are different in quality and kind from those typical of their institutions, as well as from much that is considered standard professional development. It may be building structures that encourage a respectful dialogue between and among school and university personnel, or modeling more collaborative stances toward learning and support, enunciating important ideals . . . or leaving room for emergent goals. (p. 25)

The fifth theme Lieberman and Grolnick noted was dealing with the funding problem. Most of the networks have received considerable funding from private or corporate foundations, and continued pursuit of funding to support the networks' activities brought with it tensions (e.g., choosing names for the networks that would appeal to, not offend, potential funders and negotiating with funders their right to chart the course and content of the networks). Perhaps the most significant tension within this theme for our analysis relates to the difficulty of assessing networks' "productivity" or "impact":

Learning in networks can be powerful, but it is often indirect—a result of new commitments and friendships, the exposure to new ideas, contacts with and observation of others' work, long-term involvement with many kinds of educators, growing cosmopolitanism and openness to ideas. This view of learning presents a measurement and evaluation problem that has not yet been solved in ways that satisfy the expectations of many funders or confirm the concrete experiences of those who view reform networks as the most appropriate forms of professional growth and learning. (Lieberman & Grolnick, 1996, p. 26)

Lieberman and Grolnick noted several tensions within the networks: negotiating between the network's overarching purposes and its daily "work," balancing outsider and insider knowledge and expertise, creating structures that allow for

centralization and decentralization, dealing with the inevitable increased formal-ization that comes with a network's growth, and making decisions about member-ship, both inclusion and exclusion. As they successfully negotiate these tensions, networks provide multiple opportunities for teachers to learn.

But what do they learn? Lieberman and Grolnick offer several hypotheses. For example, networks provide educators with chances to label, articulate, and discuss their tacit knowledge. This articulation of tacitly held knowledge and beliefs about teaching and students serves to both dignify the educators' work and shape its substance. The networks did this by moving away from prescriptive models of professional development to models that involved problem solving and collective inquiry into challenging circumstances. The researchers note:

[The networks] tried to achieve goals of participant learning and professional competence by modeling different modes of inquiry, supporting the formation of teams to create and write school-based plans for change, finding mechanisms to encourage cross-role groups to work together, focusing deeply on particular topics, and inviting the participants to help shape the agenda in their own terms. (p. 40)

The networks, given their flattened hierarchies, also provided participants with opportunities to collaborate and to take on leadership roles, both of which have the potential for leading to new learning. But the researchers close their discussion with the claim that we need to learn more about measuring networks' impact:

Are principals more effective, are teachers teaching better, are students learning more? These are the "bottom line" questions that funders ask when they give money to support networks. Yet, as we have seen, network activity and success must be measured by understanding and tracking the connections between member involvement, learning, and active participation, as well as by observing changes in practice. Since it is always difficult to measure the relationships between cause and effect in school improvement, how can network participation and changed practice be documented to assure funders, politicians, and the public that this investment is "worthwhile"? (pp. 43–44)

A third study illuminates other dilemmas in understanding teacher learning in such networks. In an investigation conducted under the auspices of the Educational Policy and Practice Study at Michigan State University, Wilson, Lubienski, and Mattson (1996) observed the opportunities to learn mathematics that participants in the California Mathematics Projects (CMPs) experienced. While there are more than a dozen CMPs scattered across the state, many of them share a similar structure. Participating teachers apply to attend in the summer; in exchange for their attendance, they often receive a stipend and a month's worth of professional development activities designed to increase their leadership potential, as well as their knowledge of mathematics, innovative teaching practices, new materials and resources (including technology and curricula), and new policies about teaching, curriculum, and assessment.

In our research, we observed four different CMP sites, each for a week. We documented discussions and presentations and collected calendars and handouts. We interviewed participants and teacher-leaders. The range of topics was impres-sive: Teachers were presented with information about portfolios and performance assessments, about state policy mandates, about how to teach diverse students.

TABLE 1
Topics for Discussion at the CMP Sites

California-specific topics	National topics	CMP commitments

Curriculum developments and materials
  NSF projects
  Replacement units
    Multiplication
    Gulliver's travels
	NCTM standards
	  Curriculum
	  Teaching
	  Assessment
	
	New Standards Project
		Long-range goals and strategies
		
		Ongoing professional development
		
		Developing, nurturing, deploying, and sustaining teacher leadership

California Mathematics Council
  Professional development opportunities
  Renaissance Project
  Marilyn Burns
  EQUALS
	Systemic reform efforts
	
	NCTM activities and projects
		Making connections and facilitating collaborations in an effort to be inclusive, not exclusive

CLAS development
  Timeline
  Scoring
State department policy documents
  1985 Framework
  1991 Framework
  It's Elementary
		A K–14 scope
		
		The "gift of diversity"
		
		The development of a set of "common beliefs"
		  About mathematics
		  About teaching
		  About kids

Other projects Family Math		Teachers must know mathematics if they are to teach mathematics in powerful ways Projects are regionalized

Teachers worked with new calculators and technology designed as tools for innovative mathematics teaching. Participants were also offered multiple opportunities to talk about their experiences and to act as leaders for other teachers. We offered in our analysis a tentative list of the goals and commitments that we noted across the four CMPs (see Table 1).

In addition, throughout the summer sessions, teachers were also offered many opportunities to learn mathematics. In fact, we saw mathematics everywhere. At almost every turn, leaders tried to turn the group's attention to mathematical connections. The days always started with a problem and often ended with one. Leaders constantly probed participants for connections. Unlike much professional development of the past, then, subject matter—in this case, mathematics—was part and parcel of the ethos.

This is quite an accomplishment. The discourse was technical and professional: Talk of permutations and factorials filled the air, along with talk of portfolios and performance assessment, of the California Learning Assessment System and NCTM, of the California Mathematics Council and new standards. There was much to be learned about mathematics teaching and learning: reforms, research, instructional strategies, educational philosophies, pedagogical commitments.

Yet, as we looked closely for the mathematics, we saw some patterns. Mathematics was respected and constantly pointed to but seldom pushed on. Teacherleaders worried about embarrassing participants who offered wrong answers. Opportunities to discuss underlying mathematical ideas were missed, repeatedly.

Although the set of mathematical activities and discussions we observed was diverse, sustained inquiry into mathematics was rare. The teachers and leaders mentioned mathematical concepts with frequency, but these statements and labels were rarely parsed or pursued. On the heels of many of the math activities they had participants work on, leaders often asked one of the questions we had in mind as we observed: "What's the math in this problem?" In response, participants generated lists. And the lists were filled with key mathematical concepts. The language was there, as were math activities. In spades.

For whatever reason, those spades were not turned. The ideas captured in the labels, the terms, those lists of bona fide mathematical concepts, processes, and algorithms were only rarely probed—and even then only briefly. Math activities were described and performed, the mathematics therein often listed. And the lists were accurate. But elaboration was rare, explication rarer still. We did not conclude that leaders and teachers were incapable of explicating and applying many of the concepts we heard named, but the fact that we saw very little such explication or investigation made us wonder why, and we offered our three hypotheses as a partial explanation for this phenomenon. With an agenda crammed with commitments and reforms—teach for understanding, use small groups, develop alternative assessments, and acquire vast professional knowledge among them—mathematics sometimes gets elbowed out. But it gets elbowed out for reasons that go well beyond the fullness of the reform platter. American schooling has been characterized by an anti-intellectualism that has fundamentally shaped the nature of teacher-student interactions. It seems likely that that same antiintellectualism might seep into professional development opportunities, unless those opportunities are purposefully designed to counter that trend. Moreover, scholars have already noted that teachers are both the target and the tool of the current reforms (Cohen & Ball, 1990). Teaching cannot change without teacher commitment and leadership, yet teachers themselves have rarely had the chance to develop the mathematical knowledge on which these reforms depend. This paradox lies at the heart of the work of the California Mathematics Projects, indeed at the heart of all professional development.

COMMON THEMES IN CONTEMPORARY PROFESSIONAL DEVELOPMENT AND RESEARCH ON TEACHER LEARNING

What do professional networks all over the country have in common with science instruction in Cambridge or history and English teachers looking at books in Washington? Several themes strike us as significant. Before we begin this discussion, however, we remind readers of two things. First, we selected only highly regarded research. The efforts described here are among some of the best in the country. Second, most of the work described is long term, unfolding even

as we write this chapter. Therefore, this discussion concerns what is in the literature thus far, not what is to come.

That said, we explore here several themes that run across the extant, published research on teacher acquisition of professional knowledge. First, all of the projects involved communities of learners that are redefining teaching practice. Although many of these projects started as funded professional development or research projects, most of them have continued to exist long after funding is over. Florio Ruane's and Featherstone's groups asked to continue, and the teachers who met one another in the networks kept in touch with one another, offering mutual support. This suggests to us that the participants have re-created their practice and found ways to include in their work lives time to inquire into and about teaching. As Karen, a participant in the McDonnell Project, said, "What I'm realizing is that I need to build this reading into my life" (Wineburg & Grossman, 1998, p. 353). The CGI participants, too, reconceptualized their practice, and for teachers who made it to Level 4, teaching included inquiry into students' mathematical thinking as well as instruction.

A related and second theme across these cases is the idea that teacher learning ought not be bound and *delivered* but rather *activated*. This positions the "what" of teacher knowledge in a much different place than it has been. Traditionally, professional development has been conceptualized as a dissemination activity: locate new knowledge relevant to teaching, package it in an attractive manner, and get it into the hands of teachers. Yet, the Cheche Konnen researchers found that giving teachers a new curriculum was not enough to enact the change envisioned in that curriculum. It was only when they redirected their studies to helping the teachers understand their own knowledge that, they argue, changes occurred. This observation appears to be reinforced by the findings of the CGI researchers; teachers did not necessarily transform themselves into inquirers simply because they learned about children's thinking. Thus, in addition to asking them to reconceptualize their teaching, these projects also require teachers to reconceptualize professional development.

Essentially, what these professional development projects appear to be doing when they ask teachers to become scientists or mathematics learners or book club participants is to engage them as learners in the area that their students will learn in but at a level that is more suitable to their own learning. Teachers appear to be acquiring knowledge of subject matter and of students (both specific and more general), but the knowledge they are acquiring seems broader and more diffuse than knowledge of a particular curriculum taught to children. This is true of the Literary Circle, of the McDonnell Project, of the Cheche Konnen Project, and of IMT. And while it seems clear that the knowledge teachers acquire in these projects could and should be helpful to them, it is not clear what the relationship is between that more general knowledge and the specific curricula or students that the participants encounter in their practice. However, it is important to note that Kennedy (1998), in an analysis of in-service programs, found that programs that focused on subject matter knowledge and knowledge of students were likely to "have a greater impact on student learning than are programs

that focus on teaching behaviors'' (p. 10). This suggests that current professional development is, indeed, on the right track.

A third commonality is the privileging of teachers' interaction with one another. These projects appear to have similar assumptions about the pedagogy of professional development; all appear to be aiming for the development of something akin to Lord's (1994) ''critical colleagueship.'' The projects use different mechanisms for the development of that collegiality, but each project struggles with how to build trust and community while aiming for a professional discourse that includes and does not avoid critique. And it appears that the factors that shape the development of that community might vary if the professional development is conceptualized as school-based versus outside of the confines of a teacher's home school.

Other themes are more methodological. The research reported is labor intensive and qualitative, and it involves substantial commitment to examining teacher talk in interview and group conversations and teachers' classroom behaviors. Each research project struggles with ways to document teacher knowledge, and several have developed discourse analyses of group talk. Discourse analysis techniques appear to appeal to this broad array of researchers for two reasons. First, the knowledge developed in these projects is both individual and collective, and one measure of the knowledge of the community would focus on the language and norms used by the group during discussions. Second, as the Cheche Konnen researchers note, the knowledge of such groups is ''in motion,'' consistently growing and changing. Thus, part of the appeal of discourse-analytic techniques might be that they acknowledge and use that dynamic aspect of socially held knowledge rather than ignore it by presuming more static conceptions of knowledge.

Two other research-related themes concern not what we see but what we do not see often enough. Kennedy (1998), in reviewing the professional development literature in mathematics and science, found that CGI was one of the only projects that linked studies of teacher learning and knowledge to student achievement. Furthermore, CGI researchers were able to document differences in teaching behaviors as a consequence of participating in CGI. Other research on professional development and teacher learning would benefit from conceptualizing research agendas that enable similar analyses.

CGI research offers another important contrast. Despite researchers' best intentions, it is still difficult for readers to know what the participants specifically learned in many of the professional development projects discussed herein. We are persuaded that they learned to talk in groups, that they learned to critically appraise each other's practice and ideas. All participants appear to be acquiring knowledge of professional discourse and its norms. But what of subject matter or students or teaching? CGI research is the exception to this rule. Recall that the researchers had developed a framework of problem types and children's thinking. Their goal was to have teacher-participants learn that framework and use it in their practice. Over time, the researchers used a variety of means—a CGI belief instrument with a Likert scale, interviews with and observation of

teachers and students, and a knowledge assessment with a repertory grid technique—to measure teachers' knowledge of the framework (Fennema, Franke, Carpenter, & Carey, 1993; Loef, 1990). Analyses across these different instruments allowed them to demonstrate and document what knowledge of children the teacher-participants had acquired. Consider a description of one teacher:

At the end of Year 2, the data from the experimental study indicated that Ms. J ranked near the top of the experimental group on knowledge of the addition/subtraction framework. More than most of the other teachers, she was able to identify the problem types, their relative difficulty, and their related solution strategies. She was able to correctly identify which problems children in her room could solve and which solution strategies they would use.

At the end of Year 4 when Ms. J's knowledge was assessed using repertory grid techniques (Loef, 1990), we gathered data that more analytically described her knowledge of the addition/subtraction framework. Her knowledge was extensive, accurate, hierarchically organized, and integrated in a complex way. She could identify problem types, even those that were written to be ambiguous so that the action words did not indicate an action in the modeling of the solution for it (Megan picked 6 apples. Tom picked 9 apples. How many apples were picked?), and she demonstrated knowledge of the complexity of children's thinking in the domain. Interwoven with Ms. J's knowledge of problem types and solutions were pedagogical concerns about the use of counters, relevance of the problem context to children, the language used in problems, choice of number size, and selection of problems for which a variety of strategies could be used.

Ms. J's knowledge was organized into two different levels: (a) global knowledge of children's solutions that involved direct modeling or counting, and (b) instantiations of modeling and counting solutions for specific problems. What drove this organization was how children think about the problems and solutions, not how adults think about the same problems. (Fennema, Franke, Carpenter, & Carey, 1993, pp. 563–564)

The description goes on, and the researchers offer other descriptions both of what the teachers knew and of how their knowledge changed (e.g., Fennema, Carpenter, Franke, & Carey, 1992). Granted, the preceding description is part of an article that focuses only on one teacher: Ms. J. Such a focus enables this careful description of what the teacher knew about children's thinking and the nature of that knowledge. Other research reviewed here has not had that luxury, for researchers must report on both the nature of the professional development (its content and pedagogy) and the processes by which the communities of learners coalesced. However, future research will need to begin offering more detailed analyses of what exactly teachers learned within those communities.

Other researchers have, in fact, started such work. For fear of overemphasizing mathematics teaching in our review, we have not described QUASAR (Quantitative Understanding: Amplifying Student Achievement and Reasoning), a large-scale middle school mathematics reform project with a rich database of teacher and student learning (Silver & Stein, 1996, 1997; Stein, Grover, & Henningsen, 1996; Stein & Lane, 1996; Stein, Silver, & Smith, in press). Other studies have been conducted by the Center for Teaching Policy and the National Partnership for Excellence and Accountability in Teaching, as well as researchers at the National Center for Improving Student Learning and Achievement in Mathematics and Science (e.g., Lehrer & Schauble, n.d.). Of course, the capacity of researchers to tie measures of teacher learning to measures of student learning

is also challenged by the lack of robust and standardized measures of student learning in many fields.

CHALLENGES FACED BY PROFESSIONAL DEVELOPMENT PROJECTS AND RESEARCHERS

But we do not wish to suggest that future research on teacher acquisition of professional knowledge is simply a matter of doing what CGI researchers have done or connecting professional development to classroom teaching and student achievement. CGI researchers have been working on their project much longer than researchers involved with these other projects. And they are able to draw on relevant mathematics-related research, as well as measures of student learning, that other researchers do not have access to. Besides, we believe that such simple, straightforward solutions are not sufficient, since the research we have reviewed suggests a set of challenges inherent in contemporary efforts to document teacher learning and knowledge growth. We highlight those challenges here.

Before we launch into a discussion of the challenges, recall the larger context of professional development. As Ball and Cohen (in press) note, we have no professional development "system." Teacher learning is fragmented. Teachers patch together a lifelong curriculum of professional development in odd and assorted ways. Some teachers pursue any opportunity to learn with passion, while others attend workshops when mandates arrive in their school mailbox. Some teachers work in schools and school districts where leaders have a theory of teaching, learning, and change that drives decisions about what opportunities teachers have to learn (e.g., Elmore, 1997). Others work in contexts where little thought is given to either how teachers learn or when. The research reviewed here was conceptualized and implemented within this random, sometimes voluntary, sometimes mandated, always fragmented system. That larger context, we conjecture, is a significant factor that shapes both what happens within professional development and, therefore, what researchers are able to learn.

One challenge is rooted in the poor reputation of traditional professional development workshops. Teachers are loathe to participate in anything that smacks of 1-day workshops offered by outside "experts" who know (and care) little about the particular and specific contexts of a given school. Similarly, researchers appear hesitant to study traditional professional and staff development: Why study something that so many teachers dismiss as less than helpful?

In response to the growing sense that there are features of promising professional development (recall the lists we noted at the beginning of this review) that would lead to better professional development, many thoughtful educators are creating alternative professional learning contexts, among them the book clubs, networks, and study groups reviewed here. But little is known about the specifics entailed in systematically constructing such opportunities to learn, and so researchers interested in studying teacher learning within these new environments find themselves researching a phenomenon while they (or others) are trying to build it. Studying a phenomenon while one creates it always presents

particular problems, for two distinct reasons. For one, the endeavor is complicated because one's attention must be bifocal: creating meaningful professional development and doing rigorous research. Brown (1992) discusses this problem in the context of creating and studying "design experiments," a concept coined by Collins (1992). The goal of design experiments is to create innovative learning environments and simultaneously study the behavior and cognition of the participants. But as Brown notes, such work requires a tension between attending to teaching and attending to research:

> As a design scientist, it is necessary to tease apart the major features of enticing learning environments: the role of teachers, students, and researchers; the actual contribution of curricula and computer support; methods by which distributed expertise and shared meaning are engineered, and so forth. There is a constant tension between designing an exciting classroom for happy campers and maintaining research standards of control and prediction. (p. 173)

Contemporary efforts to help teachers acquire professional knowledge share another challenge with design experiments. As Brown (1992) argues, design experiments are messy, so much so that they are a "methodological headache for traditional psychology": "Components are rarely isolatable, the whole really is more than the sum of its parts. The learning effects are not even simple interactions, but highly interdependent outcomes of a complex social and cognitive intervention" (p. 166).

Indeed, most researchers we read explicitly or implicitly referred to the messiness of this kind of research. Grossman, Wineburg, and Woolworth (1998) discuss the implications:

> Given the challenges of collecting and analyzing data on complex, longitudinal, multi-faceted projects, how do we address the issue of evidence of teacher development? How do we define learning in these contexts? Given that much of the data consists of teachers' discourse in group settings, how do we analyze discourse to investigate the learning of both individuals and the group as a whole? What timetable is appropriate for beginning to trace changes in actual classroom practice? And how can we develop analytical approaches that are rigorous yet respect the complexity of the enterprise? (pp. 1–2)

Furthermore, as these thoughtful researcher-professional development leaders construct their projects, the research base from which they can draw varies considerably. Mathematics research on children's thinking and knowledge has a depth and breadth that other fields do not yet have. CGI researchers were able to draw on a wealth of research related to children's thinking that other researchers did not have available.

And things are more complicated still. Much as we would like to, we cannot mandate learning, only attendance. All professional development programs confront this challenge; even when attendance is voluntary, teachers arrive at professional development programs with clear ideas of what kinds of "knowledge" are most helpful and relevant to their ongoing learning. New activities, new curricula, new instructional tools and tricks are welcome. Seldom do teachers

come to a professional development program assuming that their views of knowledge or subject matter or students need to change. And teachers' call for new tools and techniques is a legitimate one; all of us who teach are always in need of additional "tricks of the trade."

But most professional development that aims for the acquisition of professional knowledge assumes that teachers must engage in learning that goes beyond picking up new techniques. Thus, another challenge in professional development involves bridging the chasm between what one's clients—the teachers—want and expect and one's own goals. And because one is working with adults, and their need for new techniques is genuine, most ongoing, high-quality professional development entails a constant negotiation: of content, of purpose, of control, of discourse style. Richardson (1992) calls this the "agenda-setting dilemma." Doing research in such a context is equally challenging, since there is no simple "treatment" that one administers to the subjects (here, teachers). Furthermore, there is no agreed upon test of the results. The terrain shifts, the discussions and activities take unanticipated turns. The subjects are adults; they argue, resist, walk out, demand responsiveness. They are learners entitled to voice their opinions. The McDonnell participants explain:

> It is tempting for advocates of teacher community to assume it is easy for groups of teachers, not used to working with each other (sometimes actively avoiding each other) to come together and establish norms of professional civility. Our experience belies this romantic conception. Conflict is a natural process in a diverse group of 20 people—people who represent different backgrounds, subject matter training, social and political perspectives, and beliefs (sometimes diametrically opposed) of what constitutes good teaching. As outsiders in this community, we could mediate conflict in ways that were difficult for insiders to do.
>
> Whenever researchers approach their work as participant-observers, they face the question of how to balance these two roles. As the initiators of this intervention, we served a pivotal function. Initially, the community we envisioned was to be structured around a set of professional development activities instigated by the researchers. By providing the time and space for a community to emerge, however, we were in fact asking teachers to assume a greater agency in their professional development. In some instances, the research agenda was out of sync with the level of trust the group had developed. . . .
>
> While from the outset it was clear to all the participants that we were engaged in a research activity, aspects of that role (such as the omnipresent tape recorders) proved troubling for some members of the community. As participants we were also members of an emerging community and found ourselves increasingly aware of the fit between project activities, our expectations and the professional culture we had entered. While at times we thought it necessary to nudge the group in a direction of our interest (e.g., the research agenda), we also came to appreciate the challenges teachers face, both on a personal and organizational level, when they are asked to rethink the accepted norms and values of their professional culture. (Thomas, Wineburg, Grossman, Myhre, & Woolworth, 1998, p. x)

In this context, it is no wonder that current research is chock-full of descriptions of process: Process is the single thing that one can count on. But what teachers come to know about subject matter or teaching or children or pedagogy depends, in part, on what the project leaders and participants negotiate.

These negotiations of content and process are complicated by yet other factors, which lead us to several other challenges. One such challenge relates to Ball's point concerning a lack of a forum for discussions of teaching:

Politely refraining from critique and challenge, teachers have no forum for debating and improving their understandings. To the extent that teaching remains a smorgasbord of alternatives with no real sense of community, there is no basis for comparing or choosing from among alternatives, no basis for real and helpful debate. This lack impedes the capacity to grow. (Ball, 1994, p. 16)

We would argue that equally important is the lack of norms and expectations for such discourse. The projects reviewed here are carefully constructed, led by thoughtful researchers and teachers. Yet, almost to a study, the one consistent result is that helping teachers learn to discuss and think and talk critically about their own practice can be painful and consumes considerable energy. Groups have to move beyond politeness and "that's fine for you" to Lord's (1994) critical colleagueship. This involves developing norms, a language, trust, and a sense that change is desirable and expected, not merely possible. Ball and Cohen (in press) argue that such work requires shifting the discourse of teaching from a "rhetoric of conclusions" to a Schwabian "narrative of inquiry" that focuses on practical reasoning (Fenstermacher & Richardson, 1993), to a discussion of conjectures and possibilities rather than of definitive answers and scripts for behavior.

Research on teacher learning in these settings suffers considerably, for funding often ends just as the group learns to be critical. All many researchers can say is that the teachers learned to talk to one another, but little is reported about what they learned.

Perhaps the most formidable challenge is one endemic to all education. Learning, real learning, is hard work. You read, you think, you talk. You get something wrong, you don't understand something, you try it again. Sometimes you hit a wall in your thinking, sometimes it is just too frustrating. Yes, learning can be fun and inspiring but along the way, it usually makes us miserable. And to move forward, we often have to acknowledge that which we do not know. Ball and Cohen (in press) theorize that teacher learning requires some disequilibrium and that important teacher learning emerges only from occasions when teachers' extant assumptions are challenged: "Situating professional development in materials, teaching, and incidents that may stimulate some productive disequilibrium offers useful territory for teachers' learning." Teachers who sign up for a professional development experience expect to learn about new theories of learning or new instructional strategies. They do not expect to have their knowledge held suspect or their previous practices questioned. And admitting that you have done the wrong thing in the past or do not know the subject matter you teach is unsettling. Yet, professional development designed to help teachers acquire new professional knowledge, especially subject matter knowledge, can often involve just that.

We pause to tell a story: In a recent course that the first author was teaching for history teachers, the class had been happily reading a history about the French Revolution by Schama, *Citizens*. The students were excited; they had not had a chance to learn history in a while, and Schama's story was captivating, if complicated. For the first week, the discussion centered on examining Schama's rhetoric:

How was he making arguments? What was he trying to persuade the reader of? Energy and spirits in the class were high, discussions lively.

The next week, the discussion turned to the content of the book, and in a move familiar to all students and teachers of history, Wilson asked the students to create a time line of the events and characters in the book: Who was doing what? When? Why? The previous lively discussions died, the room was silent, and having a discussion was like pulling teeth. Several days into this, Wilson asked the group what was wrong: "I feel like I'm 16 years old again back in school, worried about a test, scared of what I don't know," one previously enthusiastic teacher said. Her eyes brimming with tears, another teacher explained, "When we were talking about what Schama was doing, I didn't have to worry about whether I understood the story. When you asked us for the time line, it felt like you were testing my knowledge. That's not why I'm here."

One might dismiss this as a clash between the teachers' expectations and Wilson's, but we believe the story is relevant to perhaps the most critical challenge to research. Learning is hard. Studies of schools—especially high schools (Cusick, 1983; McNeil, 1986; Sedlak, Wheeler, Pullin, & Cusick, 1986)—demonstrate how students bargain the hard stuff out of the curriculum. Those students are not evil, or lazy. Learning is hard. And we live in a culture that does not necessarily reward or value knowledge. Students sensibly try to make school easier and to avoid work that will bring them no immediate reward. The intellectualism of the current standards reform movement does not acknowledge this core of anti-intellectualism in American society.

As professional development takes more authentic, more substantive forms—in an effort to provide teachers with the knowledge they need to teach students—it flies in the face of the tradition of schools, not to mention the traditions of in-service and staff development. As Little (1989) noted, "The market-driven and menu-oriented character of much [traditional] staff development [left] the field vulnerable to content that [was] intellectually shallow, gimmicky, or simply wrong" (p. 178). Leaders of "new and improved" professional development are aiming for something more substantive and substantial, something more intellectually rigorous. Aware that they need to negotiate content and process with their adult learners, and equally aware of the need to attract—and keep—their voluntary attendants, professional development projects might find themselves facing attempts at similar bargaining down (or out) of content. And not because teachers are uncommitted to change. Contemporary reforms—of curriculum, of assessments, and of professional development—assume a valuing of knowledge that is not part of the current coin of the realm in American schooling. And teachers, many of whom feel beleaguered in the face of the insistent waves of criticism of the U.S. educational system, do not want to spend their free professional time admitting to what they do not know.

For researchers of teacher knowledge, this is a particular problem; to document what teachers know, one must assess knowledge. Some of those assessments might look like, or at the very least feel like, tests. Even if an assessment is done

in an interview, it can still feel like an oral examination. But we have an obligation to move beyond documenting what teachers say they know, no matter how difficult the interpersonal aspects of such research may be. How do we know that teachers' "knowledge" is knowledge? As Fenstermacher (1994) asserts:

There are serious epistemological problems in identifying as knowledge that which teachers believe, imagine, intuit, sense, and reflect upon. It is not that such mental activities might not lead to knowledge; rather, it is that these mental events, once inferred or expressed, must be subjected to assessment for their epistemic merit. (p. 47)

Fenstermacher (1994) goes on:

There is much merit in believing that teachers know a great deal and in seeking to learn what they know, but that merit is corrupted and demeaned when it is implied that this knowledge is not subject to justification or cannot or should not be justified. The challenge for teacher knowledge research is not simply one of showing us that teachers think, believe, or have opinions but that they know. (p. 51)

Thus, it is to the advantage of researchers interested in documenting teacher learning to begin to immerse themselves in issues of teacher knowledge, since we presume that what teachers learn becomes a form of knowledge that they then use in their practice.

WHERE TO RESEARCH?

The activities of staff and researchers of contemporary professional development efforts seem promising, even inviting. We would like to spend our time in the company of such colleagues. Yet, it also seems an appropriate time to take stock, in an effort to yield more consistent and insightful research results. We conclude our essay with four observations.

Our first observation involves a semi-ahistorical tone in contemporary work. The researchers tell thoughtful and personal stories of their struggles to create these communities of learners and of the importance of focusing teachers' attention on students and their ideas, on subject matter worth learning. We have traditions of such work in the United States, both within and outside the boundaries of teacher education, and it would behoove all of us interested in the development of high-quality professional development to pay more attention to Duckworth's (1987) experience with teacher study groups or the tradition of child study that emerged from the Prospect School (Carroll & Carini, 1991). For those interested in understanding book clubs, reading histories of those clubs might inform the work (e.g., Gere, 1997).

Our second observation concerns the need for subject-specific investigations of teacher learning. If teachers are to acquire subject matter knowledge, and subject matter knowledge is acquired differently across disciplines, then one would anticipate disciplinary differences in professional development. Such differences are clear in this small sampling. English and history teachers read books, mathematics teachers did math problems, science teachers engaged in experiments and scientific inquiries.

Our third observation is that future research on teachers' acquisition of professional knowledge must attend to issues of teacher knowledge. Stories of teacher learning presume that teachers learn something. The "what" of teacher learning needs to be identified, conceptualized, and assessed. This will require making informed decisions about one's assumptions regarding the nature of teaching knowledge (Fenstermacher, 1994) and building models of that knowledge against which to measure teachers' acquired knowledge. This work—part empirical, part conceptual—will entail at least three parts. One involves delineating the content of teacher knowledge: What categories of knowledge should good teachers possess? In studies of good teachers, what knowledge do these teachers possess? A second line of work involves understanding more about the ways in which teaching knowledge is held and accessed. This would involve building a conception of teacher knowledge that accommodates both the CGI framework of students' mathematical thinking and the Cheche Konnen canonical stories. Third, researchers would need more understanding of how teaching knowledge enables practice. That Ms. J surprised researchers by her applications of knowledge of student thinking suggests that there is no simple and linear map between what teachers know and what they do in classrooms. Research on teacher learning and the acquisition of professional knowledge requires better conceptualization of the mechanisms by which knowledge informs practice. This does not mean prematurely closing off one's ability to rethink the nature or content of teacher knowledge, for research will, it is hoped, push the field to a more coherent and comprehensive view of the knowledge required for and of teachers.

A fourth observation concerns the comprehensiveness of research on teacher learning and the acquisition of professional knowledge. With the exception of the CGI research, few research programs currently link studies of teacher learning to teaching behavior and student achievement. Yet, the contemporary press for accountability requires that all research, even research on teachers and their learning, include some recognition of the need for student data. This is a valid criticism of past research, for even if we knew more about what teachers learned in these enterprises, we would still need to know whether their newly acquired knowledge and skill helped them be more accomplished teachers.

Our final observation entails the explanations that are offered for why teachers learn. Researchers are making an effort to both create contexts that enable teacher learning and describe what teachers learn, but little effort has been put into explaining how those contexts enable learning. Lord (1994), for example, theorizes that critical collegiality will help teachers learn by:

1. Creating and sustaining productive disequilibrium through self reflection, collegial dialogue, and on-going critique.
2. Embracing fundamental intellectual virtues. Among these are openness to new ideas, willingness to reject weak practices or flimsy reasoning when faced with countervailing evidence and sound arguments, accepting responsibility for acquiring and using relevant information in the construction of technical arguments, willingness to seek out the best ideas or the best knowledge from within the subject-matter communities, greater reliance on organized and deliberate investigations rather than learning by accident, and assuming collective responsibility for creating a professional record of teachers' research and experimentation.

3. Increasing the capacity for empathetic understanding (placing oneself in a colleague's shoes). That is, understanding a colleague's dilemma in the terms he or she understands it.
4. Developing and honing the skills and attributes associated with negotiation, improved communication, and the resolution of competing interests.
5. Increasing teachers' comfort with high levels of ambiguity and uncertainty, which will be regular features of teaching for understanding.
6. Achieving collective generativity—"knowing how to go on" (Wittgenstein, 1958) as a goal of successful inquiry and practice. (p. 193)

These are working hypotheses about the nature of teacher learning, and future research might test these hypotheses by examining the variation across and within contexts for teacher learning. Theory development for teacher learning might then strive to explain why these characteristics matter and in what ways. For example, while CGI researchers collected data on teacher knowledge, teacher behaviors, and student achievement, their analyses do not offer us explanations of why Ms. J was able to learn as much as she did or why her knowledge took the form it did in her practice. The McDonnell Project has embraced fundamental intellectual virtues, and, by all reports, the participants are happily experiencing an intellectual life. If this new intellectualism results in better teaching and higher student achievement, we would still need to know why and how. All research on teacher learning and the acquisition of professional knowledge would benefit from more systematic theorizing about the mechanisms by which teachers learn.

In conclusion, our charge was to examine the literature on teacher learning of professional knowledge (especially content knowledge). There is much good work—both development and research—currently under way in professional development, some of which we have highlighted here. There is equally good work being conducted on the nature of teacher learning and on the professional knowledge base of teaching. Our review of the literature leads us to conclude that the field is oddly discontinuous; while we were able to locate many projects that offered teachers opportunities to learn, few such projects had yet completed analyses of what professional knowledge was acquired in those communities of learners. Fewer still had explicated their theories of how teachers learned and designed research to test those theories. The future of good research on teacher learning of professional knowledge lies in our ability to weave together ideas of teacher learning, professional development, teacher knowledge, and student learning—fields that have largely operated independent of one another.

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