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From Sensemaking to Knowledge Creation:
A comparison of teacher learning across two school subjects

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By

Amy Franz Coldren

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ABSTRACT

From Sensemaking to Knowledge Creation:

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Amy Franz Coldren

Teacher learning is fundamental to instructional reforms that many schools are implementing in response to *No Child Left Behind*. Drawing on theories of organizational sensemaking, teacher knowledge and knowledge creation, and the subject matter context of teaching, this study sheds new light on the teacher learning process and how it is situated in school subjects. Using a longitudinal, comparative case study design, I observed and interviewed the second grade teachers at one school over three years, focusing on their participation in initiatives to improve mathematics and literacy instruction. I present my findings in three separate cases: the case of learning about teaching mathematics, the case of learning about teaching literacy, and a comparative case of teacher learning in both subjects.

In the math case, I deconstruct the teacher sensemaking process and its outcomes, the role of reifications and brokers in that process, and its relationship to teacher learning. I find that teacher sensemaking is rooted in different kinds of knowledge, takes on different forms, leads to a variety of outcomes, and is only one of several mechanisms through which teachers learn.

In the literacy case, the teachers learned not just through sensemaking but through a process of creating knowledge. I examine the components of that knowledge creation process – including recognizing and defining a problem, developing a macro-level solution, and developing a micro-level solution – and the mechanisms underlying it, dialogue and practice. Of

the three dialogic mechanisms I identify, I argue that using dialogue to combine participants' 4 explicit knowledge is a unique and fundamental part of teacher knowledge creation.

In the comparative case, I compare and contrast teacher learning across subjects by examining the teachers' participation in the respective communities in which their learning about math and literacy teaching was situated. I find subject matter differences in teachers' roles, the locus of expertise, the nature of the learning process, and the use of tools, and argue that subject matter permeates not just teaching but educational processes at all levels.

Finally, I conclude the dissertation with a discussion of the implications of these findings for the design of teacher learning opportunities.

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DEDICATION

To Greg, who never wavered,

and

To Devon and Ivy, who brought perspective

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CHAPTER ONE

INTRODUCTION

Schools all over the country are heeding the call to improve student achievement by reforming classroom instruction. In this era of *No Child Left Behind*, policymakers are looking to teachers to change their teaching, for example by requiring them to use new curricula or different instructional approaches, in their search for ways to raise standardized test scores. As the chief agents of instructional policy (Cohen, 1990), teachers, and teacher learning and change, are fundamental to the success and/or failure of efforts to reform classroom instruction. The effect on teaching and learning of policies aimed at changing instruction is contingent on the understandings that teachers construct of such policies as well as on the meaning they assign to them. Hence, in order for instruction to be an effective policy lever – one that induces teachers to change their practice in the intended direction – we need to fully grasp how teachers construct understanding; that is, how they learn and change. In other words, we need to be able to unpack the teacher learning *process*.

The terrain of teacher learning and change as a subject of scholarly inquiry is quite broad. Historically, scholars have assumed three different perspectives on teacher learning, viewing it as either a behavioral, cognitive, or situative process (Putnam & Borko, 2000; Greeno, Collins, & Resnick, 1996). In addition, topics such as pre- and in-service teacher training (including professional development), teacher socialization, teacher knowledge, and teacher knowledge development are all relevant to the broader topic of how teachers learn. Finally, scholars have more recently considered how organizational theories such as sensemaking – how participants in organizations construct understandings of their world (Weick, 1995) – can help us to better

understand teacher learning in schools. Sensemaking theory emphasizes the interpretive, social, and ongoing nature of constructing understanding, moving us away from a conceptualization of learning as something that occurs at formally designated times and in predetermined ways (in professional development workshops, for example). On the contrary, teachers might engage in sensemaking any time they encounter a message about teaching they have difficulty understanding (a policy directive for example) or experience an event they find puzzling (e.g., a classroom lesson that students failed to grasp). Furthermore, the sense teachers make – the understandings they construct of puzzling messages and events – is partly dependent on their identity, including their knowledge, beliefs, and current practices. Thus, applying a sensemaking lens to the study of teacher learning forces us to broaden our notion of what teachers learn as well as where and how that learning takes place.

Only a few studies to date have explicitly examined the teacher sensemaking process (Coburn, 2001). So while it is clear that sensemaking theory has the potential to enlighten the study of teacher learning, the teacher sensemaking process remains somewhat of a black box. Hence, one of the primary purposes of this dissertation is to examine the process of teacher sensemaking and its relationship to teacher learning in order to better understand sensemaking as a mechanism through which teachers learn.

This dissertation also aims to fill gaps in our understanding of the relationship between subject matter and the teacher learning process. The subject matter context is glaringly absent from the literature on teacher learning. Even though subject matter has been shown to be a key context of teaching (Stodolksy & Grossman, 1995; Stodolsky, 1988) and plays a key role in how teachers construct opportunities to learn (Spillane, 2000), few studies have compared teacher learning across subjects. Much of the theoretical work on teacher learning takes a subject-

neutral stance on how teachers learn, while empirical work is typically situated in a single school subject, examining particular professional development initiatives in mathematics, reading, or science. 13

In this dissertation I apply a sensemaking framework to unpack the teacher learning process across two school subjects. The purpose of this study is twofold: first, to better understand the teacher sensemaking process and how it relates to learning and second, to examine how the teacher learning process is constructed similarly and differently across school subjects. Using a longitudinal case study design, I observed the second grade teachers at one school over the course of three years as they participated in initiatives to reform both their mathematics and literacy instruction. My dissertation is a set of three interrelated, yet independent papers that came out of this study¹. The first paper (Chapter Two) is a case study of teacher learning about mathematics instruction which examines the teacher sensemaking process and its relationship to teacher learning. The second (Chapter Three) is a case study of literacy which illustrates how the teachers not only learned through a process of sensemaking but engaged in a process of ongoing knowledge creation of which sensemaking was merely one part. Finally, the third paper (Chapter Four) is a case study that compares and contrasts the teachers' participation in the respective mathematics and literacy communities in which they engaged in learning about instruction. In the remainder of this introduction I will provide a brief overview of the methods I used to conduct the study², followed by a description of each of the three papers.

¹ Each paper includes its own introduction, theoretical framework, methods, findings, discussion, and conclusion and therefore can be read as a stand-alone.

² These methods pertain to all three papers.

This dissertation is based on a longitudinal case study of the second grade team at Wayne Elementary School³, located in a small city outside Chicago. Wayne serves a diverse student population of approximately 400, with 55% of students characterized as low income and 68% as coming from racial/ethnic minorities. At the time of my study, Wayne's district was grappling with an achievement gap between white majority and African American and Latino minority students. Though the gap was apparent in schools across the district, it was most acutely felt at Wayne, given the school's relatively high proportion of low income and minority students. In an effort to boost student achievement at Wayne, school and district leaders enacted reform initiatives in the two core subjects, mathematics and literacy. In mathematics, the district switched from a traditional to a reform math program, providing Wayne teachers with a series of ten professional development workshops that were designed to support their use of a reform curriculum. In literacy, Wayne stakeholders partnered with a faculty member from a nearby university to create an initiative that would support the teaching and learning of literacy in early primary classrooms.

In light of the reform initiatives under way in both mathematics and literacy, Wayne was an ideal site at which to explore how teacher learning is similar and different across school subjects. Furthermore, while the math initiative targeted second and third grade, the literacy initiative targeted first and second grade. Hence, I focused my study on the second grade teachers because they were the only teachers in the school who participated in both initiatives on an intensive basis.

³ All names throughout the dissertation have been changed.

Beginning in the fall of 2000, I spent an average of two days per week over the course 15 of two academic years in the field observing and interviewing teachers and leaders. I focused my data collection on the work of the four second grade teachers, including their classroom teaching, their participation in the math and literacy initiatives, and their interactions around instruction that occurred outside the classroom. I observed formal meetings, including professional development, grade level, and faculty meetings in which the teachers discussed instruction; the teachers' informal interactions before and after school, at lunch, and during common prep periods; and the teachers teaching in their classrooms. As I observed these events, I took copious notes that I later used to write detailed narratives of what transpired. Some formal meetings were also audio-taped or video-taped and later transcribed. In addition, following my periodic observations of their teaching, I interviewed each of the second grade teachers. Observing and interviewing the teachers throughout the course of the study allowed me to trace the evolution of their classroom practices, and particularly what and how they learned and changed over time. I also interviewed key players in both reform initiatives, from the school principal to outside consultants. All interviews were audio-taped and later transcribed. Finally, in the third year of the study, I conducted an interview with each of the second grade teachers as a follow up to my intensive data collection of the prior two years.

Now that I have described my overall methodology, I will provide a brief overview of each dissertation chapter.

Teacher Sensemaking: The Case of Learning about Mathematics Instruction

In Chapter Two, I view teacher learning about mathematics instruction through a sensemaking lens in order to press on what we know about teacher sensemaking and its relationship to teacher learning and change. This paper is situated in the literatures on

organizational sensemaking (Weick, 1995), communities of practice (Wenger, 1998), and 16
teacher knowledge (Munby, Russell, & Martin, 2001; Cochran-Smith & Lytle, 1993).

I find that teacher sensemaking is rooted in different types of knowledge, takes on different forms, and leads to different outcomes. Under certain circumstances, sensemaking is not successful in that teachers are not able to construct plausible understandings of messages about instruction that they find puzzling. Their sensemaking failure may be due, in part, to a lack of brokers who can effectively span the boundary between teachers' classrooms and the communities of practice where puzzling messages about instruction originate. Furthermore, I find that the sensemaking process is highly dependent on reifications that serve to focus conversations with colleagues or experts in which teachers try to make sense of the messages or events that puzzle them. Finally, I argue that not all learning is sensemaking. Rather, sensemaking is just one of several mechanisms, including interpretation and doing math, that together constitute an overarching teacher learning process. How these findings press on sensemaking theory and our understanding of the teacher learning process is discussed.

Knowledge Creation: The Case of Learning about Literacy Instruction

In Chapter Three, I set out to frame the study of teacher learning about literacy instruction using a sensemaking lens. However, as I proceeded with my data collection and initial analyses, it became clear that a sensemaking framework allowed me to capture only one part of a much broader and more captivating story: a story about knowledge creation. In order to tell the complete story about how the teachers learned about literacy instruction, it was necessary to broaden my conceptual framework to include not only organizational sensemaking (Weick, 1995), but theories of knowledge creation (Nonaka, 1994; Engestrom, 1999) as well.

Using this expanded framework as a conceptual guide, I find that the Wayne teachers 17 engaged in a process of knowledge creation that includes three primary components: recognizing and defining a problem, creating a macro-level solution, and creating a micro-level solution. Moreover, participants created knowledge through two mechanisms – dialogue (including sensemaking, combining knowledge, and interpretation) and practice. The relationship between sensemaking and knowledge creation is discussed as well as how this case presses on theories of knowledge creation.

A Comparison of Teacher Learning about Mathematics and Literacy Instruction

In Chapter Four, I examine the similarities and differences in the teacher learning process across mathematics and literacy. I use three domains to frame this work – subject matter as a context for teaching (Talbert & McLaughlin, 1993; Stodolsky & Grossman, 1995; Siskin, 1994) and school leadership (Stein & D’Amico, 2000; Burch & Spillane, 2003), teaching and teacher learning as situative processes (Greeno, Collins, & Resnick, 1996; Putnam & Borko, 2000; Wenger 1998), and teacher knowledge (Munby, Russell, & Martin, 2001; Cochran-Smith & Lytle, 1993; Shulman, 1986).

I find that the teachers’ learning was situated in communities of practice that grew up around each subject matter. While these communities were created in response to the same district pressures and for the same purpose – to improve teaching and learning in order to eliminate an achievement gap in both subjects – they differed along one key dimension, the nature of teachers’ participation in these communities and in their primary enterprise – learning. I argue that subject matter is a key defining element of teacher learning in that it shapes, along three dimensions, teachers’ participation in those communities in which such learning takes place. First, the roles teachers played in each community differed by subject matter. Second, the

nature of participants' work and of the kinds of knowledge involved in that work, particularly 18 the positioning of practice and of practical knowledge, depended on the subject. Finally, the ways in which tools were used to mediate the learning process differed by subject. The implications of these subject matter differences are discussed.

Conclusion

Finally, in the conclusion of the dissertation, I summarize my findings, discuss their implications for the design of teacher learning opportunities, and identify topic areas in need of future research.

CHAPTER TWO
TEACHER SENSEMAKING: THE CASE OF LEARNING ABOUT MATHEMATICS
INSTRUCTION

For many years, educational scholars have studied teacher learning and change as part of a long-standing effort to improve teaching and learning in schools. The terrain of teacher learning is quite broad and touches a vast array of topics ranging from pre- and in-service teacher education to teacher knowledge and knowledge development. Recently, scholars have added to this list teacher sensemaking – the process by which teachers select, interpret, assign meaning to, and act on puzzling cues they perceive in their environment (Weick, 1995; Thomas, Clark, & Gioia, 1993). Several recent studies have taken a sensemaking approach to understanding how teachers learn, and more specifically, how teachers learn about and interpret policy (Coburn, 2001; Spillane, 2000; Yanow, 1996; Cohen & Weiss, 1993; Hill, 2001). Applying a sensemaking perspective to the study of teacher learning emphasizes such learning as an interpretive and social process.

The purpose of this paper is to view teacher learning through a sensemaking lens in order to press on what we know about teacher sensemaking and its relationship to teacher learning and change. While I recognize that sensemaking is an important component of teacher learning and change, I find that sensemaking is merely one of several sub-processes through which teachers learn. Though in this paper I foreground the sensemaking process, I will also distinguish teacher sensemaking from other sub-processes through which teachers learn about teaching – interpretation and doing math. Recognizing that teacher learning is not limited to the

sensemaking process alone affords a more holistic and accurate picture of the overarching phenomenon of teacher learning and change. 20

This paper is an intensive case study of how the second grade teachers in an urban elementary school learn about math teaching and learning. I observed and interviewed these teachers extensively over the course of three school years as they engaged in their work. Specifically, I find that teacher sensemaking is rooted in different types of knowledge: practical and propositional, and that sensemaking rooted in practical knowledge takes two forms: retrospective and prospective. In addition, the type of knowledge in which the sensemaking process is rooted is associated with sensemaking outcomes, and specifically, whether or not sensemaking is successful. I find that sensemaking is not always a success in that teachers do not always construct plausible understandings of messages they find puzzling. This sensemaking failure may be due, in part, to a lack of brokers who can effectively span the boundary between teachers' classrooms and the communities of practice where certain messages about instruction originate. Furthermore, I find that the sensemaking process is highly dependent on reifications that serve to focus conversations with colleagues or experts in which teachers try to make sense of the messages that puzzle them. Finally, I argue that not all learning is sensemaking. Rather, sensemaking is just one of several sub-processes, including interpretation and doing math, that together constitute the overarching teacher learning process. Before I present these findings in depth, I will outline my conceptual framework and describe my methodology.

Framing the Work

This work is situated in the literatures on sensemaking, communities of practice, and teacher knowledge. I will provide an overview of each of these domains in turn.

Sensemaking is the process of individuals making sense of, or constructing understandings of, their world. Specifically, sensemaking in organizations is the process by which participants select, interpret, assign meaning to, and act on cues they perceive from their environment (Weick, 1995; Thomas et al., 1993). By constructing meanings for equivocal cues in ways that are consistent with their identities and cognitive schemas, participants reduce ambiguity and uncertainty in their organizational lives.

The purpose of sensemaking is to create “a structure of shared meanings and understandings based on which concerted action can take place” (Choo, 1998, p. 79). People engage in sensemaking to “exchange and negotiate their views in order to arrive at a common interpretation” (Choo, 1998, p. 3). This view of sensemaking assumes that a group of individuals developing shared understandings of some cue is not only possible, but easily accomplished through a process of negotiation. On the contrary, I argue that developing shared understandings can be problematic. Furthermore, I find that teachers can engage in the sensemaking process without coming away with a plausible understanding of the puzzling cue at all.

The sensemaking process is distinct from interpretation (Weick, 1995). Whereas the process of interpretation takes as given the object to be interpreted, the process of sensemaking includes the act of constructing what is to be made sense of in the first place (Weick, 1995). Thus, “The process of sensemaking is intended to include the construction and bracketing of the textlike cues that are interpreted, as well as the revision of those interpretations based on action and its consequences. Sensemaking is about authoring as well as interpretation, creation as well as discovery” (Weick, 1995, p. 8). In contrast to the process of interpretation, “Sensemaking

begins with the basic question, is it still possible to take things for granted? And if the answer is no, if it has become impossible to continue with automatic information processing, then the question becomes, why is this so? And, what next?" (Weick, 1995, p. 14). 22

Scholars have identified numerous circumstances under which people can no longer continue with automatic processing, namely when they experience some kind of interruption to their ongoing flows of experience. Such interruptions trigger the sensemaking process as people attempt to construct an understanding of what has happened and what to do next. One kind of interruption is ambiguity, which arises when there are multiple interpretations of an event. A second kind of interruption is uncertainty, which arises when one is ignorant of any interpretations of an event (Weick, 1995). Similarly, people switch from automatic to conscious processing when they encounter an experience that is novel, when they experience a discrepancy between expectations and reality [specifically when an event occurs that is not expected or an event that is expected does not occur (Mandler, 1984)], or when they engage in a deliberate initiative in response to a request for an increased level of conscious attention (Louis & Sutton, 1991).

All of the interruptions that trigger sensemaking lead people to extract puzzling cues from the environment for the purpose of constructing or reconstructing understanding. These cues are the "stuff" of sensemaking, or what sensemaking is about, and the context in which they are embedded affects which cues are extracted and how they are interpreted. Furthermore, the process of noticing cues in the first place is influenced by perceivers' habits, their beliefs about what is, and their beliefs about what ought to be (Starbuck & Milliken, 1988). Thus, noticing results from interactions of the characteristics of stimuli with the characteristics of perceivers

(Starbuck & Milliken, 1988). Sensemaking is very much grounded in identity construction 23 and is in the service of maintaining a consistent, positive, self-conception (Weick, 1995).

Though in the process of sensemaking people make sense of cues in ways that are consistent with their individual cognitive frameworks and worldviews, sensemaking is very much a social process. Conduct is contingent on the conduct of others, whether those others are imagined or physically present (Weick, 1995). Furthermore, social discourse is a key means by which sense gets made: “The basic mode of sensemaking is discourse, for it is through talk that organizational members find out what all others think, and it is through talk that people persuade, negotiate, and reshape their points of view” (Choo, 1998, p. 67).

Another fundamental tenet of the sensemaking process is that it is retrospective; sensemaking occurs through a process of reflecting on past events (Weick, 1995). In other words, an event can become an object of attention only after it has occurred. Hence, people make sense of that which has already happened. However, I argue that not all teacher sensemaking can be most accurately depicted as retrospective. Rather, sensemaking can be prospective instead.

In sum, sensemaking is one mechanism through which teachers learn. Teachers encounter cues in the environment (policy messages for example) that in some way interrupt their work, or their thinking about work. By paying attention to those cues and making sense of them, they either accommodate or assimilate the cues (Piaget, 1972). If the teacher accommodates the cue, she restructures existing knowledge to make room for it. If she assimilates the cue, she encodes it into existing knowledge frames (Piaget, 1972), changing its meaning to make it fit with current understandings. Accommodation, or the restructuring of knowledge, is the kind of learning necessary for teachers to transform their practice in the spirit of many instructional reforms

(Cohen & Barnes, 1993). But as I will show, engaging in the sensemaking process does 24
guarantee that a teacher will construct a plausible understanding of a puzzling cue, let alone
restructure her existing knowledge in order to accommodate it.

Research on sensemaking. Empirical studies of organizational sensemaking have
explored sensemaking processes at the top of organizations, viewing top managers and CEOs as
key organizational sensemakers (Gioia & Chittipeddi, 1991; Thomas et al., 1993; Gioia, Thomas,
Clark, & Chittipeddi, 1994; Starbuck & Milliken, 1988). Some discuss the dual processes of
sensemaking and sensegiving, arguing that those at the top of the organization make sense and
then somehow package what has been made sense of for constituents and stakeholders (Gioia &
Chittipeddi, 1991). While shedding light on how upper-level managers make sense, these studies
do not tell us much about sensemaking processes at lower levels of the organization. Teachers, as
street-level bureaucrats, are the final brokers of instructional practice. Thus, how they construct
and reconstruct understanding of puzzling cues about instruction – how they make sense of those
cues – shapes how they implement instructional policy.

Several studies in education have highlighted how learning about instructional policy is
an interpretive process, making an important contribution to our understanding of policy
implementation (Coburn, 2001; Spillane, 2000; Yanow, 1996; Cohen & Weiss, 1993; Hill,
2001). All of these studies have interpretation as their focal point and yet interpretation and
sensemaking are not the same (Weick, 1995). Few have applied a strictly sensemaking lens to
the study of teacher learning, though Coburn (2001) is a notable exception. In her examination
of how teachers collectively make sense of reading reform, Coburn identified three sub-
processes of sensemaking. Constructing understanding through interpersonal interaction is a
process whereby teachers, together with their colleagues, construct understandings of what

policy messages mean. Gatekeeping is a process by which teachers' professional communities, once they construct an understanding of a given message, decide to engage with the idea or dismiss it. Finally, negotiating technical and practical details is a process of teachers translating ideas into classroom practice. 25

Even though she applies a sensemaking frame to her work, Coburn (2001) defines sensemaking rather broadly as action "based on how people notice or select information from the environment, make meaning of that information, and then act on those interpretations" (p. 147). If one were to apply this definition to organizational life, it would appear that all information-processing is sensemaking. In other words, people engage in sensemaking whenever they perceive and pay attention to cues from the environment, process those cues, and take appropriate action or inaction. In contrast, I interpret the sensemaking process more narrowly, paying close attention to the conditions organizational scholars have noted that precipitate the sensemaking process: those interruptions to people's ongoing flows of experience that cause them to switch from automatic to conscious processing. Thus, I argue that the process of teacher sensemaking is more limited in scope, and is distinct from other learning sub-processes that when taken together give a more complete picture of how teachers learn.

In addition, the teacher sensemaking research to date has paid little attention to the role of reifications in the sensemaking process. Cobb, McClain, Lamberg, & Dean (2003) point out that "The use of tools and artifacts is an underdeveloped theme in the research literature on...teacher professional development" (p. 22). Instead of "tools" and "artifacts," I use the term 'reification,' defined as "The process of giving form to our experience by producing objects that congeal this experience into 'thingness.' In so doing we create points of focus around which the negotiation of meaning becomes organized" (Wenger, 1998, p. 58). Substituting the word 'sensemaking' for

‘negotiation of meaning,’ reifications are objects that create points of focus around which 26 sensemaking becomes organized. The process of reification, in relation to sensemaking, is akin to what Weick (1995) describes as the bracketing of cues from one’s ongoing flows of experience. However, I am less interested in the *process* of reification or the bracketing of cues than I am in examining the implications of ‘reifications’ as *objects* on which the sensemaking process is focused. In this paper I press on our understanding of the sensemaking process by deconstructing the role of reifications in that process.

Teacher Knowledge

This study also considers the relationship between teachers’ knowledge and the sensemaking process. Literature on teacher knowledge covers a large terrain. In a recent review of this literature, Munby, Russell, and Martin (2001) highlight the complexity of this domain and conclude that there are two different broadly-defined categories of knowledge relevant to teaching: practical knowledge and propositional knowledge. Practical knowledge is the knowledge teachers have of classroom situations and the practical dilemmas they face in carrying out purposeful action in these settings (Carter, 1990; Munby, Russell, & Martin, 2001). Practical knowledge is similar to insider knowledge, or knowledge that is generated by teachers for teachers in particular classroom contexts (Cochran-Smith & Lytle, 1993). Propositional knowledge on the other hand is knowledge about teaching derived from theory and research. This kind of knowledge is similar to outsider knowledge, or knowledge that is generated by scholars for teacher consumption (Cochran-Smith & Lytle, 1993)⁴.

⁴ Scholars distinguish between knowledge form and type. Shulman (1986) for example identifies several types of knowledge that comprise the knowledge base for teaching including content knowledge, pedagogical content knowledge, curricular knowledge, knowledge of learners, and so on. He argues that these types of knowledge can take on different forms, including propositional, case, and strategic knowledge. However, in their extensive review of the

generally concluded that teachers' prior knowledge frames the way they interpret and respond to policy messages. However, I take this assertion a step further to argue that the kind of knowledge at the root of teachers' sensemaking efforts is related to sensemaking outcomes.

Sensemaking at the Boundary

Finally, the idea of boundary is important in the study of sensemaking. Many (but not all) of the cues teachers make sense of originate outside of teachers' immediate professional contexts. That boundary between the communities where cues originate and teachers' classrooms must be navigated. Two types of interconnections between communities of practice can aid this process. Brokers, as individuals who make connections across communities of practice, are in a position to translate cues that originate in one community (e.g., the district office) into the practices of another (e.g., teachers' classrooms). Boundary objects on the other hand, are a particular type of reification that serves as an interconnection between different communities of practice. The purpose of boundary objects is to coordinate the perspectives of participants in different communities, though each community only has partial control over the interpretation of such objects (Wenger, 1998). I argue that interconnections at boundaries are a key factor in the sensemaking process.

literature, Munby et al. (2001) highlight the complexity of and tensions inherent in the different perspectives on the field of teacher knowledge. For the purpose of my study, the distinction between propositional/outside knowledge and practical/inside knowledge is of primary importance. But I also recognize that these forms of knowledge can be associated with different types of knowledge, for example propositional knowledge about learners vs. practical knowledge about learners.

Methods

This chapter is a longitudinal case study of the second grade team at Wayne Elementary School.

Site Selection

Wayne Elementary School, a K-5 school in a small city outside Chicago, was undergoing reform in both mathematics and literacy at the time of the study. For this reason, Wayne was an ideal site at which to explore questions about teacher sensemaking, learning, and change in relation to instructional reform efforts. Wayne serves a diverse student population of approximately 400 students, with 55% of students characterized as low income and 68% of students coming from racial/ethnic minorities. I focused my study on the second grade team due to their involvement in both mathematics and literacy reforms⁵. The members of the second grade team remained constant over the course of the study and included four teachers, as described in Table 2.1.

⁵ Their involvement in literacy reforms included their participation in district-wide professional development related to reading instruction as well as their participation in an intensive collaboration with university faculty to create a balanced literacy program in the early primary grades (i.e., first and second grades) at Wayne. Their involvement in mathematics reforms included their implementation of a district-adopted reform mathematics curriculum as well as their participation in a series of professional development workshops provided by university faculty that were designed to support their use of a reform mathematics curriculum. Only the second and third grade teachers participated in this workshop series for mathematics instruction. Thus, the second grade team was the only grade level team in the school to participate in the university collaboratives in both subject matters on an intensive basis. I chose to study the second grade team in order to be able to compare and contrast how the teachers learned about and from reform initiatives in both mathematics and literacy, though their learning about mathematics teaching is the focus of this chapter.

Description of Second Grade Team Members⁶

	Years Full Time Teacher	Years at Wayne	Highest Level of Education	Race/Ethnicity	Age
Heather	1	1	M.A., Elementary Ed.	African American	26
Karen	3	3	B.A., Elementary Ed.	Caucasian	43
Marcia	23	13	M.A., Elementary Ed. w/ reading concentration	Caucasian	44
Sondra	24	22	M.A., Elementary Ed.	African American	59

Data Collection

Beginning in the fall of 2000, I collected data an average of two days per week over the course of two academic years with strategic follow-up the third year. I focused my data collection on settings in which teachers and others talked about anything related to mathematics instruction. These settings included formal meetings such as professional development workshops, faculty/staff meetings, and grade level meetings as well as less formal settings in which teachers engaged in discussions about mathematics instruction such as during lunch, prep periods, and before and after school. Most observations were recorded as field notes in detailed narrative form, though some formal meetings were also video- or audio-taped and then transcribed. Data collection focused on the second grade teachers' participation in the above meetings and informal interactions. I also observed each of the four second grade teachers teach in their classrooms at multiple time points over three years. See Table 2.2 for a descriptive summary of the observational data.

⁶ Descriptions pertain to Year 1 of the study.

Observational Data

	Year 1	Year 2	Total
Formal Meetings			
Math Professional Development Meetings	9	5	14
Staff Meetings	7	6	13
SIT ⁷ Meetings	2	2	4
Grade Level Meetings	8	8	16
Informal Interactions			
Observations of lunchtime, prep periods, & before/after school	19	32	51
Classroom Observations: One classroom observation corresponds with each teacher interview described below			

In addition to these observations, I conducted several in-depth semi-structured interviews with each second grade teacher over time. Interviews typically followed my observation of the teacher teaching math and delved into both the particular lesson I observed as well as the teacher's math teaching more generally. I probed each teacher's thinking about math teaching and learning by asking how she felt about the math curriculum and what she believed students need to know in math before they leave the second grade. I pressed her to reflect on her teaching practice by asking questions about what I observed her do in the classroom. I also focused my questioning on her learning and change, asking what changes, if any, she had made or was currently making in practice, who, if anyone, was helping her to make those changes, what challenges, if any, she was experiencing in making those changes, what did she learn, if anything, from various professional development experiences, and who or what did she turn to for advice or guidance with respect to teaching math. In addition to interviewing the second grade teachers, I also interviewed a variety of school and district leaders. These interviews

⁷ SIT is the School Improvement Team.

instruction at Wayne. All interviews were tape recorded and transcribed. See Table 2.3 for a descriptive summary of the interview data.

Table 2.3

Interview Data

	Year 1	Year 2	Year 3	Total
Administrators				
Principal	2	2	---	4
District Asst. Supt.	1	---	---	1
Math Leaders				
Workshop Facilitator	1	---	---	1
2nd Grade Teachers				
Heather	2	3	1	6
Karen	2	3	1	6
Marcia	2	3	1	6
Sondra	2	2	1	5

Data Analysis

I began my analysis of field notes by reading each set and extracting the excerpts pertaining to math instruction. I then divided these math-related excerpts into chunks, with each chunk representing a discrete conversation or activity, identifying new chunks by a change in topic or direction. I assigned each chunk a code for the kind of activity that was most characteristic of it – either dialog or activity. Chunks coded as dialog were further coded as sensemaking, sharing and reflecting, and teaching.

Sensemaking chunks were those in which a teacher or teachers conveyed and attempted to address, usually by asking questions, some kind of interruption to practice or their thinking about practice. Using my theoretical framework as a guide, I specifically coded as sensemaking instances in which teachers addressed some kind of ambiguity [multiple interpretations of a cue (Weick, 1995)] about an issue or a discrepancy between expectations and reality (Mandler,

1984). Once I coded these chunks as sensemaking, I coded those in which teachers were 32 making sense of a past event as retrospective while I coded those in which teachers addressed some aspect of future practice as prospective. I also coded each sensemaking episode for the kind of knowledge in which it was rooted – either practical or propositional – as well as for any reifications that were involved, including classroom stories, excerpts from the curriculum, and district policies.

I then coded each sensemaking episode for whether or not it was successful. By successful I mean the sense-maker, by engaging in the sensemaking process, was able to construct a plausible (Weick, 1995) explanation for, or understanding of, whatever ambiguity or discrepancy triggered the sensemaking process, and furthermore, was able to resume practice. Sensemaking failure occurred when the sensemaker did not construct a plausible explanation or understanding and/or did not know how to definitively proceed in practice, leading the sense-maker to repeatedly try and make sense of the issue over time⁸. Coding for success or failure proved difficult when episodes were considered in isolation – it often was not clear from looking at individual episodes whether or not the sensemaker successfully resolved the discrepancy at that time. It was only through observing teachers and talking with them over time that I could determine the extent to which their attempts to make sense were successful. Hence, I assigned each sensemaking episode one of several topic nodes including district policy (further broken down into curriculum and assessment), students and student understanding, how to prioritize

⁸ Note that “success” is determined from the sensemaker’s perspective. In other words, a teacher who successfully makes sense of an issue has resolved the issue in a way that makes sense to *her*, constructing an understanding that is plausible (Weick, 1995). The understanding she constructs say, when making sense of district policy, may or may not be aligned with policymakers’ intentions. In other words, from an outsider’s point of view, although she may have successfully resolved the issue from her own perspective, she may not have necessarily gotten it “right.”

instruction, and pedagogy, and grouped episodes by topic to examine how sensemaking 33
about certain hot topics played out over time. I also looked at teacher interview data to examine
how teachers talked about these topics over time. This shed light on their understandings of and
beliefs about those topics and on whether or not they made sense of those topics successfully.

‘Dialog’ chunks not coded as sensemaking were coded as sharing/reflecting and teaching.
Chunks coded as sharing/reflecting include conversations in which teachers shared some aspect
of their own classroom practice, for example statements about what they do or what their
students do. Chunks coded as teaching include those in which the facilitators or other
participants introduced or “taught” a concept or idea such as the kinds of rich mathematical
discourse that are possible in reform classrooms or a new technique for teaching multiplication.
These two kinds of dialog are not mutually exclusive and meeting chunks were typically
assigned more than one. Together they constitute an implicit process of interpreting the
messages that teachers encountered in talking with one another about teaching. Finally, meeting
chunks that were not coded as dialog were coded as activity. Activity codes include doing math
and doing some other activity (such as reading texts or watching video clips).

To analyze my interviews I extracted the excerpts in which the teachers talked about
math teaching and learning and coded these for content. Content codes include the Everyday
Math program, math assessments, materials, strategies, and students. Coding the data this way
allowed me to construct a timeline for each teacher with respect to her thinking and practice
related to each of these topics. This enabled me to see how teachers’ understandings of and
practices related to these issues changed and did not change over time. I was able to compare
these data with my observational data to shed light on teachers’ thinking about the issues I had
observed them trying to make sense of in conversations with colleagues and/or experts. I also

closely examined teachers' reports of changes they had made or were currently making in 34 practice, and any challenges they had experienced or were experiencing to determine if, on any of those occasions, the teachers engaged in sensemaking. Specifically, I coded as sensemaking those occasions on which they had perceived some kind of ambiguity or discrepancy stemming from their own classrooms and took some kind of action to try and resolve it. I examined how teachers made sense on these occasions, including whether they experimented with a different approach in the classroom or went to their colleagues for guidance.

My coding scheme was both data and theory driven. My theoretical framework informed the coding process but I also used categories that emerged from the data to press on my theoretical frame. Using emergent patterns as the basis for asking more focused questions of the data, I further refined my coding scheme and analysis in an iterative process.

Backdrop to Mathematics Instruction

In 1998, the district adopted a new, reform mathematics curriculum, the University of Chicago Everyday Math program, which is aligned with the NCTM standards. This curriculum de-emphasizes traditional computation and skill-based content, emphasizing instead mathematical problem solving and teaching for conceptual understanding. One prominent feature of the program is that it spirals, meaning that topics change from one day to the next but are revisited repeatedly over time in increasingly complex ways. The logic behind a spiraling curriculum is that students will understand the concept after repeated and more in-depth exposure to it throughout the school year and across grade levels.

By the start of Year 1 of the study, the Everyday Math curriculum had been in place for two years at Wayne. Though they had received training when the district initially adopted the curriculum two years before, the second and third grade teachers also participated in a series of

ten after school workshops in Year 1, facilitated by a faculty member from a nearby university and her post-doctoral fellow. The district partnered with the university to provide support for the teachers' use of a reform curriculum to teach mathematics. The workshops were not designed to support the Everyday Math program specifically, but to cover general topics related to reform mathematics such as the role of student representations in teaching and learning mathematics, student participation in classroom discourse, and the use of multiple methods in problem-solving. 35

To make the experience of teaching second grade math at Wayne come to life, consider the experiences of Heather, a first year teacher, and Marcia, a veteran.

Heather

In Year 1, Heather is a first-year teacher at Wayne who is using the Everyday Math curriculum in her own classroom for the first time. The curriculum is comprised of numerous materials for students and teachers alike, including books, workbooks, and reference manuals which Heather struggles to navigate. She admits having difficulty learning and using the program, often turning to her second grade teammates for assistance. Her unfamiliarity with the program materials leads her to spend a great deal of time at home planning her math lessons, often writing down exactly what she will say to present the content to her students. Unlike her teammates who skip lessons and combine others, Heather does not deviate from the curriculum as it is written, instead teaching each of the lessons in succession. However, her belief that students sometimes need more exposure to and/or practice with the content, and particularly with the computational skills that she believes students need to have a “solid foundation” in math, leads her to teach at her own pace, often differentiating instruction for students performing at different levels and spending more than one day on lessons she feels her students need more time

with. In sum, Heather admits this year that she is “just trying to get a feel for how things work” and despite her discomfort with the way the spiraling curriculum jumps around, she guesses that “it all comes together at the end” (Interview transcript, 1/25/01). 36

Two years later in Year 3, with two full years using the Everyday Math curriculum behind her, Heather feels more confident teaching the program, moving through it quickly (i.e., teaching a new lesson every day) and staying more focused. She follows it more closely than she ever has in the past, teaching all of the lessons and using more of the program’s homework and review materials. However, she struggles to accept its spiraling design, hesitant to just move on to the next lesson when she senses that her students need to slow down. She admits to revisiting concepts her students have trouble with even though the curriculum says to move on.

Heather may have changed her practice over the course of three years, in the end adhering more closely to the Everyday Math program, but she continued to question whether the program was serving her students well. For example, exhibiting frustration about the difficult content of a particular math lesson, she said to her teammates at lunch one day, “I hope he [the principal] can get a different math program” (Field notes, 11/30/01). Another time, at the end of Year 2, she complained that despite teaching the program all year, her students “still don’t know the basics,” pointing out that even though the curriculum spirals, “they never did get it.” Voicing her doubts about the curriculum, she said,

You know it has its pros and cons. It's quite [good]...for that higher group and it's also, you know, beneficial to some of the lower-end kids as well. No one wants to be on one particular thing for like a month. Gosh, that would be boring. But at the same time some of the stuff, they jump so fast and it's like, 'Whoa, wait a minute! Let's give them a little more practice.' (Interview transcript, 12/13/01)

In sum, though Heather did change her practice over the course of the three years, mainly by 37 adhering more closely to the Everyday Math program, the extent to which she changed her understanding of the logic behind using the Everyday Math program is less clear.

Marcia

Year 1 is Marcia's third year using the Everyday Math curriculum. In contrast to Heather, Marcia introduces the Everyday Math concepts to her students, but takes only the bits and pieces of the program that she wants to use, supplementing her limited use of the program with the "traditional pen and pencil practice" that she truly believes her students need.

By Year 3, Marcia has more fully embraced the Everyday Math curriculum, following it more closely than ever. Though she still feels a tension between the way she used to teach math and the Everyday Math approach, she is supplementing the program less and instead is "moving on with what the program says works" (Interview transcript, 12/05/01). However, she admits, "I'm still not 100% sold on it...because there's still a group that I don't think this program works for" (Interview transcript, 12/05/01). Like Heather, Marcia changed her practice, by the end of Year 3 adhering more closely to the Everyday Math program. However, at the same time she also did not appear to change her understanding of the logic of the curriculum, sometimes reverting back to more traditional, tried-and-true math instruction.

Over the course of three years, there is no doubt that both of these teachers changed their math teaching in incremental ways, though they changed their practice more readily than their understandings of the logic of reform mathematics. In the pages that follow, I explore the processes that account for the teachers' learning and the changes they made in practice as well as for their failure to change in any significant way their understandings of the logic of reform mathematics. Specifically, I highlight the role of sensemaking in the learning process and

describe the different kinds of sensemaking in which the teachers engaged, the different kinds of knowledge in which their sensemaking was rooted, and the outcomes associated with those differences. 38

Teacher Sensemaking

Scholars have identified numerous circumstances [i.e., different kinds of interruptions to people's ongoing flows of experience (Weick, 1995)] that trigger sensemaking.

I argue that the interruptions teachers experience are rooted in two types of knowledge – practical knowledge and propositional knowledge. By rooted in practical knowledge, I mean interruptions that stem from teacher practice. By rooted in propositional knowledge I mean interruptions rooted in the theoretical underpinnings of teaching and learning. I will begin by describing two different types of teacher sensemaking rooted in practical knowledge and how teachers make sense of those cues that cause interruptions to their practice and their thinking about practice.

Sensemaking Rooted in Practical Knowledge

Two kinds of sensemaking are rooted in practical knowledge – retrospective and prospective sensemaking. Retrospective sensemaking involves teachers making sense of cues from their own or from a colleague's past practice. This kind of sensemaking is about an event that has already happened. Prospective sensemaking on the other hand involves teachers making sense of cues about future practice. This type of sensemaking is not about an event that has already occurred, but rather involves making sense of an idea about one's anticipated future practice, or what one might do in the classroom. I will further explain and provide examples of each type of sensemaking below.

they observe that a lesson has failed to meet their expectations in some way. In other words, in the act of teaching they experience a discrepancy between what they intended to happen and what actually happened. This discrepancy constitutes an interruption to their practice, or to their thinking about practice, which triggers the sensemaking process. If people engage in sensemaking when they experience a discrepancy between expectations and reality (Louis & Sutton, 1991), then teaching practice is rife opportunities to engage in sensemaking. Teachers use tried-and-true teaching strategies as well as experimental ones, both of which can fail to meet their expectations in practice. For example, a math lesson may find success one year, only the next year leaving students confused. Or a teacher might experiment with a new strategy, only to discover that students are completely lost. Under such circumstances, a teacher might stop to consciously process what may have caused the lesson to fail, try to construct a plausible explanation of the failure, and devise a plan to avoid such failure in the future.

Sondra demonstrates this kind of retrospective sensemaking by explaining how she made sense of her students' palpable confusion about a particular math lesson.

We're doing the input/output model. And when this [Everyday Math] program first started I followed it exactly. And then I could see some of the children were confused. So then I...read the lesson this time and I...put some of the examples on the board. But then I adapted as I went through to show the children how they would do it. And I found that worked for me. So...I always rely on their feedback to me and then I know that they don't really understand what I'm saying; so then I have to adapt it. (Interview transcript, 11/07/00)

This example illustrates how teachers engage in retrospective sensemaking as a result of the 40 failure of some aspect of practice to meet their expectations. It is retrospective in that Sondra makes sense of an event, in this case a particular math lesson, that has already occurred. Specifically, Sondra taught a lesson, specified by the Everyday Math program, and observed that some of her students were confused. The students' confusion caused an interruption to Sondra's teaching practice – her ongoing flow of experience (Weick, 1995) – that led her to stop and actively make sense of what caused the confusion and how she might change her approach to the lesson in the future in order to avoid a similar problem. When she taught the lesson again, Sondra changed her approach to include writing out and explaining sample problems on the board while relying on her students' ongoing feedback to help guide her teaching.

In this example, Sondra's act of sensemaking was successful. By successful I mean the sensemaker, by engaging in the sensemaking process, is able to construct a plausible (Weick, 1995) explanation for, or understanding of, whatever ambiguity or discrepancy triggered the sensemaking process and therefore is able to devise a solution and resume practice. Experiencing successful sensemaking means that Sondra was able to resolve the puzzle in such a way as to be able to take a definitive course of action in order to rectify the problem. Sondra surmised that the way she presented the material led to her students' confusion. The next time, she presented that material differently by writing and explaining sample problems on the board, relying on her students for further cues regarding how well they understood it and how she should proceed with the lesson. Her successful sensemaking led her to construct new knowledge about teaching (i.e., how to more effectively teach that particular mathematical content) and to subsequently change her practice.

This kind of sensemaking is rooted in practice, in that the cues teachers make sense of 41 come from inside their practice (e.g., observing that students are confused during a lesson). Because it is rooted in practice, the development of practical knowledge – the knowledge teachers have of classroom situations and the practical dilemmas they face in carrying out purposeful action in these settings (Carter, 1990; Munby, Russell, & Martin, 2001) – is at the core of such sensemaking. As in the above example, for this type of sensemaking, teachers rely on their own stores or toolkits of practical knowledge, gleaned from their professional experience, to help them make sense of practical puzzles. When they stop to make sense of a lesson that failed to meet their expectations, teachers draw on the contents of these toolkits to help them understand the problem and to devise a solution, contemplating their particular classroom context and tapping into what they know from their own experience. Once a plausible diagnosis of the problem is made, teachers then devise a plan for future practice. Sensemaking of this nature leads teachers to develop practical knowledge about teaching, such as what strategies work and do not work, what students understand or fail to understand in particular lessons, or how certain materials do and do not aid the learning process. The development of practical knowledge can lead teachers to make incremental changes to their practice.

All of the second grade teachers described occasions similar to this one in which they engaged in retrospective sensemaking in an effort to understand why a particular lesson failed to meet their expectations. On these occasions the teachers typically experienced success in that they were able to construct a plausible understanding of or explanation for the lesson “failure” and devise a definitive course of action to avoid a similar problem in the future. In other words, they figured out a way to move forward. These sensemaking episodes led the teachers to construct practical knowledge and to incrementally change their practice.

That teachers engage in this kind of sensemaking should not come as a surprise. 42

Teachers who want the best outcome for their students are keyed in to what strategies work and what strategies don't work, making sense of problems that arise in the classroom and tweaking their practice to help students achieve success. However, this kind of sensemaking presses on our understanding of what it means that sensemaking is social (Weick, 1995). While discourse among organizational participants is the basic mode of sensemaking (Choo, 1998) and teacher sensemaking has been examined particularly in the context of formal and informal meetings in which they make sense through talk (Coburn, 2001; Hill, 2001), teachers can engage in sensemaking in the classroom without ever talking with their colleagues. I do not mean to suggest that the kind of sensemaking Sondra described is not social. Rather, it *is* social but in the sense that it is situated in the interaction among the teacher, her students, and the materials (i.e., socially constructed artifacts) that constitute her particular classroom context. Rather than solving the problem by talking with her colleagues however, Sondra relied on her practical knowledge of teaching, of the materials, and of the particular group of students in front of her, to make sense of the problem.

By pointing out that teachers engage in retrospective sensemaking without interacting with their colleagues I do not mean to suggest that teachers never turn to their colleagues to help them make sense of practice-related puzzles. The second grade teachers, in addition to relying on their own practical knowledge in sensemaking, turned to their teammates to help them make sense of failed lessons. For example, during their common lunch period one day, Marcia shared with her teammates that the math lesson she taught the day before had totally flopped. Furthermore, she was unable to explain why it failed. Her teammates, upon hearing Marcia describe what happened, helped her to make sense of what went wrong. According to Marcia,

We were sitting at lunch and I was going, "Oh my God, this was the worst lesson I 43
ever did!" And they said, "Well what did you do? We thought it was fairly easy." So I
showed them and...Miss Brown [Sondra] and Miss Lanier [Heather] said, "No! No!
That's not the way to do it. Let us show you." And I think it was like a 2:00 time⁹ they
had come in and that's when they showed me [how to teach it]. (Interview transcript,
1/28/02)

The next day, Marcia admitted to her students that she had goofed the day before. She re-taught
the troublesome lesson using the method Heather and Sondra had showed her and concluded that
her students "were more successful with doing it that way" and "it was a much clearer vision for
most of them." This example of retrospective sensemaking is similar to the prior example in that
Marcia taught a lesson, observed that her students were quite confused, and then actively
attempted to make sense of what caused the confusion. However, this time Marcia took the
problem, as a reification of her practice, to her colleagues.

Sensemaking, as a social process that unfolds through dialogue, is highly dependent on
reifications. Without reifications, or points of focus around which participants in the
sensemaking process engage in dialogue, sensemaking would not take place; reifications are
what sensemaking is about. In the above example, Marcia described for her colleagues the math
lesson she thought went terribly, describing that particular Everyday Math lesson, how she
presented the content, and how her students responded. In doing so she bracketed her ongoing
flow of experience (Weick, 1995) into a reification that then served as a focal point for
sensemaking. It is important to note that the reification in this example is not limited to a
concrete object – something that can be seen and touched like the particular lesson as it is written

⁹ "2:00 time" refers to the teachers' common prep period.

in the Everyday Math curriculum – but rather is Marcia’s rendering of an excerpt from her 44 classroom practice, including her interpretation of how the lesson unfolded from beginning to end. The reification in this example takes the form of a story about classroom practice. By telling the story to her colleagues, Marcia laid the groundwork necessary for sensemaking to take place, providing a common object around which the second grade teachers could talk. Once they heard the story, the teachers could then help Marcia to make sense of it by offering an explanation to account for her students’ confusion – specifically that the way Marcia presented the material was unnecessarily difficult – along with a solution, showing her an alternative way to teach it.

Prospective sensemaking. Prospective sensemaking is making sense of cues about future practice. Rather than making sense of a discrepancy between expectations and reality as in the case of retrospective sensemaking, prospective sensemaking involves teachers making sense of ideas about teaching that they do not know how to implement in practice. While reading teaching materials and sourcebooks, participating in professional development activities, and engaging in dialogue with colleagues and experts, teachers encounter ideas about practice that interrupt their thinking, leading them to question what the idea might mean and how they might implement it in their own classrooms.

Teachers engage in prospective sensemaking when they read materials to plan for instruction and encounter cues about practice that they do not know how to interpret or carry out. For example, Heather shared how she would ask her teammates for help in lesson planning when she encountered lessons in the math program with which she did not know how to proceed,

And if it’s one [lesson] I don’t feel comfortable with, then I take it to lunch and discuss it with them [team members] and say, “What did you do with this?” and “How are the

kids?” and “I thought about doing it this way. Is that going to work?” (Interview transcript, 1/25/01) 45

Upon reading the teachers’ guide to the Everyday Math program to plan her lessons, Heather sometimes did not understand what to do or how to proceed. Her uncertainty surrounding particular lessons interrupted the planning process. Hence, she made sense of how to teach those lessons with the help of her more experienced colleagues who were able to help her devise a definitive course of action. Like the classroom story Marcia told about her failed math lesson, the particular lessons in the math program that Heather brought to her colleagues served as key reifications, or points of focus around which she and her colleagues engaged in dialogue. In other words, excerpts from the Everyday Math program that Heather brought to her teammates – a program that all of the teachers used – served as a reference point that bracketed what they were talking about, enabling them to engage in a dialogue.

Teachers also engage in prospective sensemaking when in the process of participating in professional development activities or engaging in dialogue about practice they encounter ideas that they do not know how to interpret or carry out. For example, in one workshop the teachers watched a video clip of a young student solving a math problem at the chalkboard and explaining to the class how he solved it. What the teachers saw – a second grader engaging in rich mathematical discourse – interrupted Heather’s thinking about her own practice, leading her to question how to foster her students’ engagement in the kind of discourse she observed in the video clip. She made sense of this interruption by asking the other participants what she could do to foster that kind of discourse:

After watching the clip Heather asks, “All these kids seem pretty adept at this. What do I do with the kids who can’t?” Pam [workshop facilitator] replies, “Well you don’t want

the kids to be scared...you want to make them comfortable. You can start by giving 46
them something they can do.” Susan [workshop facilitator] adds, “What Elaine [teacher
participant] did was great – draw a picture.” Diane [teacher participant] says that with
her special education kids, “I pair them up and have them work as a team.” (Field notes,
10/10/00)

In this example, Heather encounters an idea about practice – that students can engage in rich
mathematical discourse – that interrupts her thinking. Not knowing how to foster that kind of
discourse in her own classroom, Heather makes sense of the idea by asking the other participants
how she might proceed in order to elicit that kind of discourse. Specifically, she asks for, and
other participants share, practical advice – specific measures she can take to help her students
take a more participatory role in mathematical discourse. Heather draws on the other
participants’ knowledge and experience to help her make sense of this idea, leading her to
construct knowledge about practice. This example of sensemaking is prospective in that Heather
is not making sense of an event that has already happened, but instead is making sense of how to
carry out an idea in the future.

Both examples of prospective sensemaking demonstrate that dialogue with other teachers
and experts is a key mechanism through which sense gets made. When they encountered
interruptions to their planning of or thinking about future practice, teachers made sense of those
interruptions by engaging in dialogue with others, specifically asking questions and drawing on
others’ knowledge and experience to help them construct practical knowledge about what they
might do and how in the context of their own classrooms.

In sum, sensemaking rooted in practical knowledge is either retrospective, when teachers
make sense of interruptions to their practice in the form of events that have already happened, or

prospective, when teachers make sense of interruptions to their thinking caused by ideas they 47 encounter that they do not understand or know how to implement. Teachers make sense of these interruptions by drawing on their own knowledge and experience or by engaging in dialogue with colleagues and experts in order to draw on theirs. Moreover, the sensemaking process relies on reifications – e.g., those classroom stories, excerpts from the math program, and ideas about practice reified in video clips – as objects that focus and coordinate participants’ talk in their sensemaking efforts. Finally sensemaking rooted in practical knowledge is typically successful. In the case of retrospective sensemaking, teachers were able to construct a plausible account of the puzzling event as well as to formulate a plan to avoid the same problem in the future. In the case of prospective sensemaking, teachers were able to better understand how to implement the idea in their own classroom contexts. In both cases, the act of sensemaking led teachers to construct practical knowledge and to make incremental changes to their practice.

Sensemaking Rooted in Propositional Knowledge

Teacher sensemaking can also be rooted in propositional knowledge, or knowledge pertaining to the theoretical underpinnings of teaching and learning. At Wayne, the cues rooted in propositional knowledge that interrupted teachers’ thinking and practice took the form of policy directives coming out of current research on math education. Specifically, the district, in keeping with the NCTM standards, adopted the Everyday Math program (a reform curriculum) and crafted assessments that would support the program’s emphasis on problem solving and mathematical reasoning. These policy directives represented a departure from the more traditional mathematics teaching that the Wayne teachers had practiced up until, and even after, the adoption of the Everyday Math program. The adoption of a reform curriculum stood in conflict with many of the teachers’ past practices and their beliefs about and understandings of

mathematics instruction, a conflict that led them to engage in sensemaking in an effort to resolve that conflict. Marcia was one such teacher. 48

In contrast with the Everyday Math program's emphasis on students' conceptual understanding and problem solving and de-emphasis on computational skills, Marcia believed that her students needed more practice with computation than the program provided:

I don't think there's enough practice of traditional computation. I think that's really lacking. I think the philosophy of the [Everyday Math] is that they don't need as much practice of the computation, but I don't see that. I see my kids not getting a lot of experiences at home with computation from an early age and that they need it constantly, all the time. (Interview transcript, 11/15/00)

Not only did Marcia believe that the curriculum lacked the computational practice that she felt her students need, but she also questioned the appropriateness of the assessments provided by the curriculum and additional assessments designed by district leaders to support it.

I get frustrated...with this assessment that we had to do. I'm looking at these kids; I know they don't understand the concept...I feel they are not developmentally ready to do some of that assessment that our district [has adopted based on] their interpretation of what [Everyday Math] should be – [that is not] what these kids need right now.

(Interview transcript, 11/15/00)

Marcia's comments shed light on her thinking about mathematics teaching, and particularly, her beliefs about what her students need (i.e., computational practice and a different kind of assessment) to be successful in math. These beliefs set the stage for Marcia's desire to make sense of the discrepancy between the policy that all teachers use the Everyday Math program to teach mathematics and her belief that the program was not meeting the needs of her students.

Marcia, together with other teachers, engaged in sensemaking about this issue on numerous 49 different occasions, particularly during the math professional development workshops. In a workshop early on in the series for example, the following exchange took place:

Marcia shares her concerns for a minute or two, explaining that she is having difficulty with the idea of teaching this “reform curriculum” because “My low end kids need a lot of rote practice and the math games¹⁰ don’t do it.” She continues to say that there is a problem with the “home links¹¹” because with a lot of their kids, there is very little or no support at all from home. With great feeling she adds, “The reform curriculum fails these kids. They are not getting what they need from this program and me...My kids love computation.”... Pam [the facilitator] responds, saying that in her experience, “They may be able to do the problems rote [and get the right answer], but they don’t understand it at all. They still see four hundred sixty-five [as numerals]; no hundreds, tens, and ones at all.” Marcia then concedes, “We do it [the reform curriculum], but it’s frustrating at times.” Pam responds by advocating the use of manipulatives in the classroom and then thanks Marcia for her comments and moves on to the next item on her agenda. (Field notes, 9/26/00)

The district policy that all teachers use the Everyday Math curriculum to teach mathematics was at odds with Marcia’s understandings of mathematics teaching and in particular, her beliefs about the kind of instruction her students need to be successful in math. This discrepancy caused an interruption to Marcia’s understanding of mathematics teaching that led her to switch from automatic to conscious processing in an effort to try and make sense of it. The above excerpt is

¹⁰ Math games are a component of the Everyday Math curriculum aimed at developing students’ computational skills.

¹¹ Home links are the homework component of the Everyday Math curriculum.

representative of Marcia's and her colleagues' numerous attempts to make sense of this issue 50 during the professional development meetings. Like much of their sensemaking rooted in practice, teachers made sense of cues rooted in propositional knowledge by talking with colleagues and experts. In this example, Marcia posed her problem to the group, implicitly inviting them to comment in order to help her make sense of the clash between her beliefs and the adoption of the reform math program.

Unlike sensemaking rooted in practice however, sensemaking rooted in propositional knowledge is about cues that originate outside of teachers' practice. Cues such as policy messages are boundary objects, a particular kind of reification that serve as interconnections between different communities of practice, in this case designed by district and school leaders. The purpose of boundary objects is to coordinate the perspectives of participants in different communities (Wenger, 1998) by serving as the focal point of dialogue and practice among them. Although policy cues about mathematics, such as the mandate that all teachers use the Everyday Math program to teach math, are designed to align teachers' practice with district leaders' goals, such alignment is not a given.

The policy message that teachers should use the Everyday Math program to teach math reified the district's stance on math instruction, namely that a reform curriculum, and all that it encompasses, is more effective than the traditional math curriculum it replaced. This policy was a cue rooted in propositional knowledge gleaned from research in math education concerning the content, purpose, logic, and effectiveness of reform mathematics. As a boundary object, its purpose was to align the teachers' math instruction with leaders' goals. However, this policy was at odds with Marcia's practical experience – specifically, her observation that the Everyday Math program fails to meet the needs of certain students – creating a clash between the

knowledge. This clash between theory and practice created conditions ripe for sensemaking.

Unlike sensemaking rooted in practice which is often successful in that it leads teachers to develop plausible understandings of puzzling cues and definitive courses of action, sensemaking rooted in propositional knowledge is not always so successful. Teachers tried to make sense of the policy cues repeatedly, without ever constructing a plausible understanding of them. Furthermore, absent a plausible understanding of policy cues, teachers are unlikely to change their understanding *or* their practice accordingly, at least as a direct result of sensemaking¹². In other words, teachers can engage in the sensemaking process without successfully making sense of the puzzling cue, an idea to which I now turn.

Sensemaking without Making Sense

The goal of sensemaking is to “create a structure of shared meanings and understandings based on which concerted action can take place” (Choo, 1998, p. 79); people engage in sensemaking to “exchange and negotiate their views in order to arrive at a common interpretation” (Choo, 1998, p. 3). However, I argue that teachers can engage in the process of sensemaking without, in the end, making sense of whatever cue they perceived to be a problem in the first place. Furthermore, the failure of teachers to construct new understandings as a result of engaging in the sensemaking process makes it unlikely that teachers will arrive at a “common interpretation.”

Consider the above example in which Marcia attempts to make sense of the district's policy that every teacher use the Everyday Math program. Marcia says, “The reform curriculum

¹² I recognize that teachers, though they may not construct a plausible understanding of a puzzling cue, may change their practice to be aligned with the cue in response to other processes such as tighter coupling between their practice and the administration.

fails these kids. They are not getting what they need from this program and me.” She 52 interprets the district’s cue as not sensible; that the decision to adopt the Everyday Math curriculum is not in her students’ best interest. However, the workshop facilitator offers a different interpretation, advocating the virtues of reform curricula by pointing out that in traditional math programs “They [students] may be able to do the problems rote [and get the right answer], but they don’t understand it at all,” emphasizing that reform curricula foster students’ conceptual understanding. Despite this alternative interpretation, Marcia remained skeptical as evidenced in her repeated attempts to make sense of this issue over time. In another professional development workshop more than a month later for example, Marcia again raised the issue:

Marcia: I’m concerned about my lower-end children with this math series.

Elaine (third grade teacher): Well, and that’s the other problem too when you get...

Marcia: Majorly.

Elaine: Yeah.

Marcia: Majorly concerned that my kids who still are in 2nd grade and do not have a concept of number, of place value, etcetera, that this series is not the right series for them. They have a very difficult time.

Margaret (third grade teacher): We have, it’s such a discovery series though. Don’t you feel like maybe it’s better for them?

Marcia: I don’t think they discover it.

Margaret: It’s such a hands on and a...have they been doing it for the last two years?

Diane (Special Education Teacher): Like those kids might still get something. Like if you look at them, and I’m not saying to look at all your lower-end children [laughs]. But those kids still might get something.

Susan (workshop facilitator): I mean the question also is [what they get from] the other.

Marcia: They're gonna get something, they're gonna get *something*. (Meeting transcript, 11/07/00) 53

That Marcia revisits the issue of the mismatch between the Everyday Math curriculum and her students' needs in another sensemaking attempt illustrates the ongoing nature of sensemaking (Weick, 1995). Furthermore, it shows that despite prior attempts to make sense of this same issue, Marcia has not changed her understanding of it. Rather, because she has not been able to construct a plausible understanding of this issue, it remains a puzzle that warrants her attention repeatedly over time.

Moreover, Marcia's need to make sense of the conflict between the reform curriculum and what she believes her students need is linked with her identity as a teacher. Sensemaking is grounded in identity construction (Weick, 1995) and Marcia, in believing her students "are not getting what they need from this program and *me* [emphasis added]" implies that by using the program she, as a teacher who is responsible for enabling all of her students to learn, is failing to do her job. Uncomfortable with what she perceives as leaving students behind in order to implement the Everyday Math program and what this might mean for her success or failure as a professional, Marcia is compelled to repeatedly try and make sense of this issue.

Even after raising the issue on multiple occasions, Marcia did not, in the end, develop an understanding of the logic of the reform curriculum, nor did she fully embrace it in her teaching. In short, she was not able to make sense of it, describing her thinking about the math program during Year 1 this way:

I don't need anyone to come and help me with this program. I don't like the program. I'm really not using the program. I'm taking the bits and pieces that I want to and going with it. (Interview transcript, 12/05/01)

Even the following year, after having participated in the professional development sessions 54 designed to support her use of the program, her thinking had changed little:

I'm still not 100% sold on it...because there's still a group that I don't think this program works for. (Interview transcript, 12/05/01)

Not only did Marcia not change her understanding of the district policy in any significant way, but her attempts to make sense of it also did not yield a “shared interpretation” with colleagues upon which “concerted action” took place (Choo, 1998). Despite other teachers who tried to convince her of the virtues of using a reform curriculum (See Margaret’s and Diane’s comments above for example), Marcia remained skeptical, not changing her thinking in any significant way. The teachers’ inability to come to an agreement about the meaning of the policy demonstrates that the communities in which teachers learn do not necessarily embody the positive attributes typically associated with the term ‘community’. Such communities can be characterized just as readily by conflict as they can be by consensus.

The idea that the purpose of sensemaking is for organizational participants to construct a shared interpretation of some cue so that they can take “concerted action” plays out differently in schools than in other types of organizations. In businesses for example, employees from different groups, e.g. research and development, sales, and marketing, must coordinate their actions in order to accomplish the goals of the business. In contrast, teaching has been and continues to be a relatively private practice (Lortie, 1975), with individual teachers being the final agents of and ultimate decision-makers about instruction in their own classrooms. Teachers do not need to reach a consensus about, say, an instructional policy, in order to proceed with classroom instruction. Rather, they can return to their individual classrooms and decide how to

proceed behind the classroom door. Teachers' relative autonomy downplays the necessity of 55 developing shared interpretations of puzzling cues in order for the organization to function.

Finally, Marcia's repeated sensemaking attempts illustrate the key role that boundary objects play in sensemaking rooted in propositional knowledge. The policy cue was the focal point around which Marcia engaged in dialogue with colleagues and experts as part of her sensemaking efforts. Though the purpose of boundary objects such as this one is to coordinate the perspectives of multiple constituencies, such coordination is not automatic. In fact, as this example illustrates, boundary objects can lead to conflict between perspectives rather than coordination between them.

In sum, though teachers often changed their practice as a result of making sense of cues rooted in practical knowledge, they were not always able to construct a plausible understanding of policy cues that were rooted in propositional knowledge, thereby not changing their understandings, or their practice, at all. An interesting question therefore, is what accounts for sensemaking failure? I argue that one contributing factor is the lack of an effective broker to span the boundary between the source of external cues and teachers' classroom practice.

Sensemaking Failure: The Role of Brokers

Teachers used the professional development meetings as a forum for making sense of external cues related to mathematics instruction. Present at these meetings were people they viewed as experts in mathematics education: the workshop facilitators on the faculty of a nearby university and district leaders in mathematics from the central office. The teachers looked to these experts to help them make sense of and translate the policy cues that they found to be puzzling. However, the experts, in the end, sometimes failed to effectively bridge the gap

between those cues and teachers' classroom practice, unable to help teachers construct plausible understandings of what puzzled them. 56

For example, the district had designed a math assessment which asks students to solve a story problem and also requires them to explain in writing how they solved it as well as why they used that particular method. The assessment included a scoring rubric which penalizes students for failing to write acceptable explanations for their solutions, even if they solved the problem correctly numerically. Many of the teachers who participated in the professional development meetings found this writing requirement to be puzzling, believing that the assessment confounded students' mathematical understanding with their writing ability. Marcia first brought up this issue in an attempt to make sense of it during a conversation in which the participants discussed students' solutions to a math problem that Pam, the facilitator, had shared with them.

Marcia: At what point would you add a written portion to these?

Sondra: Yeah.

Marcia: There is no written portion here, and as part of our Everyday Math assessment we have a particular form that the kids are graded on. And part of that form is the written out portion of this drawing. And it's not considered complete unless it has that written part....And that is so difficult for many of our kids because now it's bringing in an issue of literacy. And based on our rubric, kids don't get as high a score if they don't include that written part....

Susan (workshop facilitator): Can they tell you the sentence and can you write it, you know...

Marcia: I suppose that we could dictate, yeah....I don't know why that would be a problem.

Sondra [quietly]: It's in a testing situation.

Susan: ...What do people do?

Marcia: It is in a testing situation.

Susan: Hmm. That's tricky.

Marcia: And that- that's just an issue that I have a concern with. [Referring to the student's picture they've been looking at] To me, this shows me... that the child understands the concept.... Writing will come later as they can- yeah, go ahead-

Pam: And when they understand the concept you want to get them to the number sentences.

Marcia: Yeah. And to me you know, a number sentence is, would be the next step- like this kid on the second grade who did the three plus you know. But then to have to come up with that written part. Really, the cream of our cream are the ones who can do that.... The other kids are struggling with that! (Meeting transcript, 9/12/00)

The conversation ends with the facilitators suggesting that before their next meeting they will discuss this matter with another faculty member at the university who is a math education expert and who may be able to shed light on this puzzle, because as Pam summarizes, "That brings up a real literacy issue."

In this example, Marcia tries to make sense of the district's math assessment which, in her opinion, is in conflict with how she thinks students should be assessed. She explicitly turns to the facilitators to help construct a plausible understanding of the issue. However, the facilitators, who were from a university rather than the district, had no knowledge of the district's assessment policy and were unable to provide an explanation for it. They were unable to span the boundary between the district leaders responsible for writing the policy and teachers' practice in order to help the teachers understand the logic behind it. Moreover, this issue came up repeatedly during the professional development meetings because of the teachers' inability to construct a plausible understanding of it, even after discussing it with the experts.

The district assessment policy was an artifact created by district leaders that, when disseminated across the district, crossed the boundary into teachers' classrooms. As Wenger (1998) points out, "It is often a good idea to have artifacts and people travel together" because "Accompanied artifacts stand a better chance of bridging practices" (pp. 111-112). Brokers, as

individuals who make connections across communities of practice, are in a position to 58
translate artifacts developed in one community (i.e., the district office) into the practices of
another (i.e., teachers' classrooms). However there were no brokers who could legitimately span
that boundary to effectively translate the assessment policy for the teachers. The workshop
facilitators, who came from outside the district, had no direct participation in either the district
leader community responsible for setting the policy or the teacher community responsible for
implementing it. They were not in a position to explain the policy nor to address how the policy
fit with the teachers' particular classroom contexts.

The teachers' repeated attempts to make sense of the assessment issue failed in that they
did not develop a plausible understanding of it nor did they buy in to it. Heather for example,
exhibited frustration at the assessment when she said,

It's frustrating for the kids and the way they're assessed with this program with the
writing and the math. We know that they need to have their practice with the
writing...being able to explain. But, you know, for a kid to arrive at a solution and don't
say [it] exactly the way you need to you only get three points out of five. That penalizes
you right there. (Interview transcript, 1/25/01)

Likewise, Marcia echoed Heather's sentiment about the assessment when she said,

My thing with that [writing on assessments] though, is if the kids cannot do the writing; if
their readability level isn't there, if their writing ability isn't there, how much of my time
am I going to spend on that aspect of it, if I know that's what's holding them down? It's
not the math....If we were to score the rubric differently, we would say it's all right to put
down 3+4 is 7 and they put down three objects and four objects and that's seven objects.
To us that's acceptable. That does tell me that this child understood that concept. But if

you look at the rubric that we've been given, the written part is oh-so-important to a 59
successful score. But to us, then you're saying, "What is this child's reading ability?"

Not, "What is his math understanding?" (Interview transcript, 11/15/00)

Both Heather's and Marcia's comments illustrate that the assessment made little sense to both teachers, even after numerous discussions at the professional development workshops with the facilitators and district personnel.

In this case, the lack of a broker to help the teachers to understand the logic of the assessment policy and to translate it into practice, was critical. The teachers needed a broker with a firm understanding of the logic of the assessment policy and of the particular classroom contexts in which the teachers were implementing the policy. Such a broker could have helped the teachers to make sense of the policy, possibly leading them to buy in to it. Or perhaps the broker, together with the teachers, would have discovered that the policy needed some tweaking in order to better fit with the local context. In any event, without a broker to accompany the policy, making sense of it was difficult, if not impossible.

Constructing Knowledge without Sensemaking

As I have shown, sensemaking can lead, though not always, to the construction of new knowledge. However, people do not construct knowledge through sensemaking alone, but through other sub-processes as well. The Wayne second grade teachers not only constructed knowledge through sensemaking, but also through interpretation and doing math. I will briefly describe these other sub-processes below and highlight how they are distinct from the sensemaking process, though a thorough accounting of them is beyond the scope of this chapter.

Sensemaking is a process that includes the act of bracketing cues from one's flow of experience that one makes sense of. Sensemaking therefore, "is about authoring as well as interpretation, creation as well as discovery" (Weick, 1995, p. 8). Interpretation on the other hand, takes the object to be interpreted as given. In other words, the process of interpreting does not include the bracketing of one's experience the way that sensemaking does. Thus, as I have shown, the teachers engaged in sensemaking when they bracketed some part of their experience for the purpose of making sense of it. They did this by extracting or pulling out of their flows of experience some aspect of their past practice (e.g., a lesson that failed to meet their expectations), of their anticipated future practice (e.g., an idea about instruction), or a policy cue (e.g., the district assessment) that interrupted their practice or their thinking about practice, in order to address it in some way; either to question it, to solve it, to challenge it, or to learn more about it.

A lot of the time however, when teachers converse with their colleagues or participate in professional development meetings, they exchange ideas or encounter messages that do not cause an interruption to their thinking that triggers sensemaking. Rather than bracketing those messages, or pulling them out of the conversation for further social consideration, they interpret those messages, assimilating or accommodating them (Piaget, 1972). Thus, teachers learn, but they do so by internally processing those ideas and messages that they so often encounter at work; when they read curricular materials and sourcebooks, talk with one another about practice, and participate in professional development activities.

In addition to sensemaking and interpretation, teachers also constructed knowledge about math teaching by actually doing mathematics. Reform mathematics represents a fundamental shift in what it means to understand and do mathematics. Prior to the penning of the NCTM standards, mathematical competence was typically defined as using standard algorithms correctly to solve problems. Traditional math emphasizes procedural understanding and arriving at correct answers. Reform math on the other hand emphasizes students' conceptual understanding of mathematics, encouraging students to use a variety of methods to solve problems so long as they understand and can explain the solution and how they arrived at it. For the Wayne teachers, the switch from a traditional to a reform math curriculum not only represented a fundamental shift in how to teach mathematics, but in what it means to know and *do* mathematics. With the adoption of a reform curriculum, the teachers were not only learning a new instructional approach, but were also re-learning what it means to know and do mathematics. Hence, a key component of the learning process was for the teachers to do reform math. In the professional development workshops in particular, the teachers practiced doing reform math by solving math problems and discussing their solutions, essentially mimicking the learning process of their students. While a thorough examination of this sub-process of learning is beyond the scope of this chapter, I explore it in more depth in Chapter Four.

Summary and Discussion

In the case of teacher learning about mathematics instruction, I found that sensemaking, though important, is only one of several sub-processes through which teachers learn. The second grade teachers at Wayne also learned by interpreting messages they encountered in their environment and by doing mathematics, both sub-processes distinct from sensemaking.

Sensemaking is a process by which teachers attempt to construct understandings of 62 interruptions to their practice or their thinking about practice. Not all sensemaking is the same however. I have found that sensemaking is rooted in different types of knowledge and takes different forms that are associated with different outcomes. Specifically, teacher sensemaking is rooted in both practical and propositional knowledge. Sensemaking rooted in practice can be either retrospective or prospective. Teachers engage in retrospective sensemaking when they make sense of an event that has already occurred that has caused an interruption to their practice or their thinking about practice (e.g., a lesson that has failed to meet their expectations in some way). Given prior work on sensemaking [particularly Weick (1995)], we should expect to see teachers engage in sensemaking that is retrospective. However, my findings indicate that not all sensemaking can be most accurately characterized as retrospective. Much of teacher sensemaking, particularly in a reform climate in which teachers are encountering new ideas, methods, and strategies in an effort to transform their teaching, is prospective, or future-oriented. Hence, teachers engage in prospective sensemaking when they make sense of an idea they encounter about what they might do in future practice. While participating in professional development activities or talking about practice in a climate of reform, teachers encounter ideas about practice that interrupt their thinking; ideas they are not sure how to interpret or carry out, or whose meaning for their own practice is unclear.

Teachers make sense both retrospectively and prospectively by discussing puzzling cues with colleagues or experts. This finding confirms that discourse is a key means of making sense (Choo, 1998). However, teachers did not always rely on talking with colleagues in their sensemaking efforts. Sometimes they made sense of lessons that failed to meet their expectations by drawing on their own knowledge and experience in order to understand the

problem and to devise a solution, without taking the problem to their colleagues at all. 63

Hence, teacher learning (through sensemaking) is not limited to formal occasions to learn or the result of interacting with colleagues, but can occur informally on the job as well.

Furthermore, sensemaking rooted in practice was typically successful in that as a result of their efforts, teachers were able to construct plausible explanations for puzzling cues as well as to devise definitive courses of future action. This kind of sensemaking can lead teachers to make incremental changes to their practice.

Teacher sensemaking was also rooted in propositional knowledge, when interruptions to teachers' practice and thinking about practice took the form of policy messages stemming from current research on math education. These policies, such as the adoption of a reform math program, clashed with teachers' beliefs and practices. The teachers attempted to make sense of the conflicts they perceived between policy and their practice by raising these issues in meetings with expert professional developers. The teachers, who often aren't privy to the development of policy and of the propositional knowledge on which it is based but rather are viewed as the consumers of such knowledge (Cochran-Smith & Lytle, 1993), sought help from experts whom they believed have access to, and who understand, that knowledge. Unlike sensemaking rooted in practice however, sensemaking about policy messages was typically not successful in that the teachers were unable to construct plausible understandings of the messages in light of what they were experiencing in the classroom. Even after raising the issue and discussing it repeatedly over time, they were unable to reconcile the adoption of the reform math program with their observation that the program appeared to be leaving some of their students behind. Hence, even though sensemaking rooted in practical and propositional knowledge involved the same mechanism – i.e., dialogue – it led to different outcomes.

Teacher sensemaking is indeed a part of the teacher learning process. However, this 64 study illustrates that teacher sensemaking is a nuanced rather than a monolithic process. In order to fully understand it and its relationship to teacher learning, we must pay particular attention to the kinds of knowledge in which it is rooted, especially because the kind of knowledge involved is associated with the outcome; sensemaking rooted in practical knowledge led to a different outcome than that rooted in propositional knowledge. Hence, teachers might construct plausible understandings of puzzling cues along with definitive solutions, as in the case of making sense of lessons that failed to meet their expectations. Or, they might engage in sensemaking repeatedly over time without ever constructing a plausible understanding of the interruption, as in the case of teachers repeatedly trying to make sense of the district's curriculum policy. Finally, teachers may make different sense of the same message, such as when the second grade teachers were unable to resolve the conflict they perceived between the curricular policy and their practice while a couple of the other participating teachers did not perceive there to be a conflict at all. Hence, this finding challenges the notion in the sensemaking literature that people readily reconstruct their understandings to accommodate puzzling messages and are able to negotiate shared understandings of those messages in the communities in which they work.

Another important finding is the key role that reifications play in the sensemaking process, particularly in those many cases when teachers engaged in dialogue with others as the way in which they tried to make sense of what puzzled them. These reifications served as points of focus around which teachers engaged in the sensemaking process. Reifications are boundary objects that help to coordinate the perspectives between participants in different communities, helping to span the boundary between different classrooms or between the teaching and leadership communities. They provided the common reference point necessary for participants

in different communities to come together through talk to engage in sensemaking. 65

Furthermore, different kinds of reifications were used in teacher sensemaking, including stories about classroom practice, representations of practice captured in video clips, excerpts from the curriculum, and policy messages. All of these reifications signaled to the group what the conversation was about and particularly, what needed to be made sense of.

Spanning boundaries is key to the sensemaking process, particularly when teachers make sense of cues rooted in knowledge developed outside their practice. This study suggests that brokers, or in this case a lack of brokers, or individuals who can effectively span the boundary between teacher communities and the communities in which propositional knowledge is developed, may be associated with what sense teachers are able to make (or in this case not able to make) of messages from outside their practice. Having brokers – those who have a legitimate understanding of teachers’ classroom contexts as well as of the logic of instructional policies – to accompany cues on their journey from outside to inside teachers’ practice, may be essential in helping teachers make sense of cues they may perceive as in conflict with their current practices. Such brokers would need to understand where teachers are coming from in order to help them understand what policies mean in the context of their particular classroom contexts.

Finally, this study illustrates that sensemaking is only one sub-process of the overarching teacher learning process. While I have intentionally foregrounded teacher sensemaking for this analysis, the teachers also constructed knowledge through other means, including interpreting the texts they read and the messages they encountered in their interactions with colleagues and experts as well as constructing understandings of reform mathematics by actually doing reform mathematics. Thus, all learning is not sensemaking.

Conclusion

My analysis began with a look at Heather's and Marcia's math teaching. We saw that both of these teachers made incremental changes to their practice over a three year period. The good news is that they learned, readily developing new practical knowledge as the result of making sense of puzzling cues rooted in practice. The bad news is that when it came to messages rooted in outside, propositional knowledge, the teachers had difficulty constructing understanding. They just couldn't construct a plausible understanding of the logic of using a math program they perceived as leaving students behind. Despite repeated attempts to make sense of the policy, the teachers, in the end, did not completely understand it or buy in to it. Indeed, sensemaking was an important part of the learning process, but engaging in it was no guarantee that teachers would construct plausible understandings of policies rooted in propositional knowledge.

CHAPTER THREE

KNOWLEDGE CREATION: THE CASE OF LEARNING ABOUT LITERACY INSTRUCTION

Changing teaching often requires teachers to learn new curricula, materials, methods, and/or ways of thinking about teaching and learning. Learning, and at times unlearning, is a key component of instructional change. Over the past few decades, three different theoretical lenses have been applied to the study of teacher learning: behavioral, cognitive, and situative (Putnam & Borko, 2000; Greeno, Collins, & Resnick, 1996). Indeed, the terrain of teacher learning is very broad and touches a vast array of topics including teacher change, pre-service and in-service teacher education, socialization, knowledge and knowledge development, and more recently, sensemaking.

The purpose of this study is to examine the teacher learning process, and specifically how teachers learn about teaching literacy. To examine this issue, I studied four elementary teachers at one school over the course of three years as they participated in an organized effort to transform their reading and writing instruction. Interested in recent work on teacher sensemaking which stresses the social and interpretive nature of the learning process (see for example, Coburn, 2001; Spillane, 2000; & Hill, 2001), I initially framed the study using a sensemaking lens. Sensemaking is a process by which people construct understandings of their world; specifically how they select, interpret, assign meaning to, and act on puzzling cues they perceive in their environment (Weick, 1995; Thomas, Clark, & Gioia, 1993). My goal was to better understand the relationship between teacher learning and the sensemaking process. However, as I proceeded with my data collection and initial analyses, it became clear that my

sensemaking framework allowed me to capture only one part of a much broader and 68
captivating story: a story about knowledge creation. While the teachers did learn by
sensemaking, that sensemaking was just one of several mechanisms involved in a much larger
and more complex knowledge creation process. Hence, in order to tell the complete story about
how the teachers learned about literacy instruction, it became necessary to broaden my
conceptual framework to include a more holistic knowledge creation process.

In our high-tech, information-driven economy, scholars of organizational behavior have
become increasingly interested in the study of knowledge creation, based on the premise that
firms on the cutting edge of knowledge development have the ability to innovate and maintain a
competitive advantage in the marketplace. Models of knowledge creation can help us understand
how teachers learn; that is, how they transform their practice through a process of creating
knowledge about instruction. Thus, I draw on two models – Nonaka's (1994) theory of
knowledge creation and Engestrom's (1999) theory of expansive learning – along with
sensemaking theory to frame the study.

Using this expanded framework as a guide, I find that the teachers engaged in a process
of knowledge creation that includes three primary components: recognizing and defining a
problem, creating a macro-level solution, and creating a micro-level solution. Moreover,
participants created knowledge using two mechanisms – dialogue and practice. I will begin by
outlining my conceptual framework in more detail and providing a brief description of my
methodology.

FRAMING THE WORK

Several scholars have developed models of knowledge creation, though no one model completely captures the knowledge creation process evident at Wayne Elementary School¹³. While the theories highlighted here framed my data collection and analysis, they were only a starting point. My data did not neatly confirm nor disconfirm any one of these models. Though some of the components of knowledge creation outlined in these models were evident at Wayne, a different model of knowledge creation emerged.

Theories of Knowledge Creation

One prominent theory of knowledge creation is based on the idea that knowledge is created through a spiral of tacit-explicit knowledge conversion processes. Tacit knowledge is personally held knowledge that is embodied in practice but is not readily articulated or shared (Polanyi, 1966; Choo, 1998). Explicit knowledge on the other hand can be expressed formally using a system of symbols such as language, and can therefore be easily communicated or diffused (Choo, 1998). “Knowledge creation centers on the building of both tacit and explicit knowledge and, more importantly, on the interchange between these two aspects of knowledge” (Nonaka, 1994, p. 20). Nonaka argues that knowledge creation is a continuous cycle of four conversion processes involving tacit and explicit knowledge. Each of these processes is defined below.

1. *Socialization* is the conversion from tacit to tacit knowledge; a process of creating tacit knowledge through shared experiences such as shared mental models and technical skills.

¹³ All names have been changed.

2. *Externalization* is the conversion from tacit to explicit knowledge; a process of articulating tacit knowledge into explicit concepts or language.
3. *Combination* is the combination of explicit with explicit knowledge through social processes.
4. *Internalization* is the conversion from explicit to tacit knowledge; embodying explicit knowledge into individual tacit knowledge through action.

In Nonaka's model, these four modes of knowledge conversion are instrumental to a five-step knowledge creation process that includes enlarging individuals' knowledge, sharing tacit knowledge through shared experiences, conceptualizing and crystallizing new knowledge, and finally, justifying and networking that knowledge. This model privileges tacit knowledge – its development within individuals, the development of shared tacit understandings in work teams, and eventually the internalization of newly developed concepts. However, I will argue that explicit knowledge plays a more prominent role in the knowledge creation process at Wayne than Nonaka's model would suggest. Indeed, his emphasis on tacit knowledge is unfounded. Knowledge creation at Wayne was largely dependent on explicit knowledge, i.e., knowledge that teachers and other participants were able to articulate through language.

Two kinds of explicit knowledge are particularly important to the Wayne case. Both inside/practical knowledge and outside/propositional knowledge played a role in the knowledge creation process. Practical knowledge is the knowledge teachers have of classroom situations and the practical dilemmas they face in carrying out purposeful action in these settings (Carter, 1990; Munby, Russell, & Martin, 2001). Practical knowledge is similar to insider knowledge, or knowledge that is generated by teachers for teachers in particular classroom contexts (Cochran-Smith & Lytle, 1993). Propositional knowledge on the other hand is knowledge about teaching

derived from theory and research. This kind of knowledge is similar to outsider knowledge, 71 or knowledge that is generated by scholars for teacher consumption¹⁴ (Cochran-Smith & Lytle, 1993). The knowledge creation process that I observed at Wayne was situated in a community of practice (Wenger, 1998) that brought together the explicit knowledge of participants from both inside and outside the school.

With respect to the *process* of knowledge creation, one critique of Nonaka's (1994) model is that it takes the existence of a fairly clear problem, task, or assignment as given and "excludes the phases of goal and problem formation, delegating them to the management as an unexamined black box" (Engestrom, 1999, p. 380). Engestrom (1999) addresses this weakness in his own model of expansive learning, arguing that the process begins with individuals questioning some aspect of accepted practice and existing wisdom. He does not identify who does the questioning, the circumstances surrounding such questioning, and how the process of questioning unfolds, however. I unpack the beginning of the knowledge creation process by closely examining how it began at Wayne. Furthermore, I argue that what happens at the beginning of the process sets the stage in profound ways for what follows.

Beyond the beginning of the knowledge creation process, Nonaka (1994) and Engestrom (1999) both take us through a sequence of steps. While Nonaka argues that the process includes

¹⁴ Scholars distinguish between knowledge form and type. Shulman (1986) for example identifies several types of knowledge that comprise the knowledge base for teaching including content knowledge, pedagogical content knowledge, curricular knowledge, learners, and so on. He argues that these types of knowledge can take on different forms, including propositional, case, and strategic knowledge. However, in their extensive review of the literature, Munby et al. (2001) highlight the complexity of and tensions inherent in the different perspectives on the field of teacher knowledge. For the purpose of my study, the distinction between propositional/outside knowledge and practical/inside knowledge is of primary importance. But I also recognize that these forms of knowledge can be associated with different types of knowledge, for example propositional knowledge about learners vs. practical knowledge about learners.

enlarging individuals' knowledge, sharing tacit knowledge, conceptualizing and crystallizing 72
new knowledge, and justifying and networking that knowledge, Engestrom presents his own
sequence of events that make up the expansive learning cycle:

1. Questioning some aspect of accepted practice and existing wisdom
2. Analyzing the situation to find out causes or explanatory mechanisms
3. Modeling the newly found explanatory relationship by constructing a model of the
new idea that explains and offers a solution to the problem
4. Examining the model by running, operating, and experimenting on it in order to fully
grasp its dynamics, potentials and limitations
5. Implementing the model
6. Reflecting on and evaluating the process
7. Consolidating its outcomes into a new, stable form of practice

These two models are similar in that they move from the development of new concepts to their
implementation, testing, and solidification in practice. Both portray a process in which new
knowledge (in the form of concepts or models) is developed and then implemented. However,
while these models are tools that help us understand *what* happens in the knowledge creation
process, another key question is *how* knowledge is created, i.e., the specific mechanisms
involved. To address this issue, I present my own sequence of stages in the knowledge creation
process at Wayne that also accounts for the specific mechanisms through which each stage is
accomplished. As stated earlier, Nonaka (1994) argues that knowledge is created through the
four conversion processes and specifically, dialogue is the mechanism through which individuals
articulate shared concepts in the crystallization stage of knowledge creation. Engestrom (1999)
is less concerned with the mechanisms underlying the steps in his model, although he argues that

debate – “questioning, criticizing, even rejecting the accepted wisdom” (p. 385) – is central. 73

In the analysis that follows, I pay particular attention to the mechanisms underlying the knowledge creation process. I argue, not surprisingly, that dialogue is a key mechanism through which knowledge is created. In addition, I will show that different kinds of dialogue play a role in the process – dialogue that allows teachers to combine explicit knowledge [similar to Nonaka’s (1994) conversion process], sensemaking, and interpretation. Note that sensemaking is only one of the mechanisms through which teachers create knowledge.

Sensemaking and Interpretation

Sensemaking is the process of individuals making sense, or constructing understandings of, their world. Specifically, sensemaking in organizations is the process by which participants select, interpret, assign meaning to, and act on cues they perceive from their environment (Weick, 1995; Thomas, Clark, & Gioia, 1993). By constructing meanings for equivocal cues in ways that are consistent with their identities and cognitive schemas, participants reduce ambiguity and uncertainty in their organizational lives.

The sensemaking process “begins with the basic question, is it still possible to take things for granted? And if the answer is no, if it has become impossible to continue with automatic information processing, then the question becomes, why is this so? And, what next?” (Weick, 1995, p. 14). Scholars have identified numerous circumstances under which people can no longer continue with automatic processing, thereby triggering the sensemaking process as people attempt to construct an understanding of what to do next. Namely, people engage in sensemaking when they experience an interruption to their ongoing flows of experience (Weick, 1995). One kind of interruption is ambiguity, which arises when there are multiple interpretations of an event. A second kind of interruption is uncertainty, which arises when one is ignorant of any

interpretations of an event (Weick, 1995). Similarly, people switch from automatic to 74
conscious processing when they encounter an experience that is novel, when they experience a
discrepancy between expectations and reality [specifically when an event occurs that is not
expected or an event that is expected does not occur (Mandler, 1984)], or when they engage in a
deliberate initiative in response to a request for an increased level of conscious attention (Louis
& Sutton, 1991). I will show that sensemaking was one of the mechanisms underlying the
knowledge creation process at Wayne.

Sensemaking differs from the process of interpretation. Sensemaking is about “authoring
as well as interpretation” and includes “the construction and bracketing of the textlike cues that
are interpreted” (Weick, 1995, p. 8). While sensemaking includes the act of constructing what is
to be made sense of in the first place, interpretation on the other hand, takes the object to be
interpreted as given. As part of the knowledge creation process at Wayne, the teachers
interpreted or processed objects such as texts, policy messages, and their colleagues’ spoken
words. I will show how this process differs from teacher sensemaking.

The three kinds of dialogue that I identify – combining explicit knowledge,
sensemaking, and interpretation – are key mechanisms underlying the knowledge creation
process at Wayne. Another is practice. While Nonaka (1994) describes a process of
experimentation in the crystallization phase, Engestrom (1999) alludes to the role of practice by
identifying an implementation stage. But exactly *how* practice contributes to the overall
knowledge creation process, as well as how it relates to dialogic mechanisms is not clear. I find
that the teachers did not just implement new concepts in their classrooms, but that classroom
practice is a mechanism, like dialogue, through which knowledge is created. Hence, practice is
not only the site of implementation, but is where knowledge continues to develop and change.

METHODS

This study is an intensive longitudinal case study of the second grade team at Wayne Elementary School. In this section I will describe my site selection, data collection, and analysis.

Site Selection

Wayne Elementary School is a K-5 school that was undergoing reform in both mathematics and literacy at the time of the study. For this reason, Wayne was an ideal site at which to explore questions about teacher learning processes, especially those surrounding instructional reform efforts. Wayne serves a diverse student population of approximately 400 students, with 55% of students characterized as low income and 68% of students coming from racial/ethnic minorities. I focused my study on the second grade team due to their involvement in both mathematics and literacy reforms¹⁵. The members of the second grade team remained constant over the course of the study and included four teachers, as described in Table 3.1.

¹⁵ Their involvement in literacy reforms includes their participation in district-wide professional development related to reading instruction as well as their participation in an intensive collaboration with University faculty to create a balanced literacy program in the early primary grades (i.e., first and second grades) at Wayne. Their involvement in mathematics reforms includes their implementation of a district-adopted reform mathematics curriculum as well as their participation in a series of professional development workshops provided by University faculty that were designed to support their use of a reform mathematics curriculum. Only the second and third grade teachers participated in this workshop series for mathematics instruction. Thus, the second grade team was the only grade level team in the school to participate in the university collaboratives in both subject matters on an intensive basis. I chose to study the second grade team in order to be able to compare and contrast how the teachers learned about and from reform initiatives in both mathematics and literacy, though literacy is the focus of this paper.

Description of Second Grade Team Members¹⁶

	Years Full Time Teacher	Years at Wayne	Highest Level of Education	Race/Ethnicity	Age
Heather	1	1	M.A., Elementary Ed.	African American	26
Karen	3	3	B.A., Elementary Ed.	Caucasian	43
Marcia	23	13	M.A., Elementary Ed. w/ reading concentration	Caucasian	44
Sondra	24	22	M.A., Elementary Ed.	African American	59

Data Collection

Beginning in the fall of 2000, I collected data an average of two days per week over the course of two academic years with strategic follow-up the third year. I focused my data collection on settings in which teachers and others talked about anything related to literacy instruction. These settings included formal meetings such as professional development workshops, meetings with district and university experts, faculty/staff meetings, and grade level meetings as well as less formal settings in which teachers engaged in discussions about literacy instruction such as during lunch, prep periods, and before and after school. Most observations were recorded as field notes in detailed narrative form, though some formal meetings were also audio-taped and then transcribed.

Data collection focused on the second grade teachers' participation in the meetings and informal settings highlighted above. Observations focused on participants' talk about their teaching practice. In addition to observing formal meetings and informal settings in which the teachers interacted, I observed each of the second grade teachers teach in their classrooms at

¹⁶ Descriptions pertain to Year 1 of the study.

multiple time points over three years. See Table 3.2 for a descriptive summary of the observational data.

Table 3.2

Observational Data

	Year 1	Year 2	Total
Formal Meetings			
Literacy Professional Development Meetings	1	14	15
Staff Meetings	7	6	13
SIT ¹⁷ Meetings	2	2	4
Grade Level Meetings	8	8	16
Informal Interactions			
Observations of lunchtime, prep periods, & before/after school	19	32	51
Classroom Observations: One classroom observation corresponds with each teacher interview described below			

In addition to these observations, I conducted in-depth semi-structured interviews with the second grade teachers as well as with a variety of individuals who served as informal and formal school leaders. Interviews with teachers were designed to probe them about their instructional practices (practices often observed firsthand by the researcher), focusing on changes they had made or were in the process of making in practice and sources of support for those changes. Interviews with leaders were designed to question them about their leadership practice, with particular emphasis on their role in literacy instruction and literacy reform across the school. All interviews were tape recorded and transcribed. See Table 3.3 for a descriptive summary of the interview data.

¹⁷ ‘SIT’ refers to School Improvement Team.

Interview Data

	Year 1	Year 2	Year 3	Total
Administrators				
Principal	2	2	---	4
District Literacy Director	1	1	---	2
External Literacy Consultants				
Literacy Project Leader	---	1	---	1
Expert Teacher 1	---	1	---	1
Expert Teacher 2	---	1	---	1
Reading Resource Teachers				
Reading Teacher 1	1	---	---	1
Reading Teacher 2	---	1	---	1
2nd Grade Teachers				
Heather	2	3	1	6
Karen	2	3	1	6
Marcia	2	3	1	6
Sondra	2	2	1	5

Data Analysis

To analyze my observational data, I broke down each meeting transcript or set of fieldnotes into chunks of conversation, assigning each chunk a consecutive number. A change in topic or a natural break in the conversation signaled the end of one chunk and the start of another. For observations of informal interactions, I extracted for analysis only those chunks in which teachers discussed literacy instruction. I then coded each chunk using a coding scheme that included nodes for what topics the participants in the chunk discussed, who was involved in the conversation, and what kinds of processes were involved. Topic nodes included instructional strategies, assessment, grouping, materials, tools, students, scheduling, school procedures, classroom management, emotions, content, discourse, and the state of the project. In the end I collapsed these nodes into four categories: instruction, students, scheduling/logistics, and the

current state and future of the project. ‘People’ nodes (who was involved) included 79
facilitator/leader and/or teachers. Process nodes included three dialogic processes –
sharing/presenting information (leading implicitly to what I call interpretation), sensemaking,
and combining knowledge. I further coded chunks identified as “combining knowledge” for the
kinds of knowledge involved – inside/practical knowledge, outside/propositional knowledge, or
both. This coding scheme allowed me to determine the frequencies of different topics of
discussion, the relative prevalence of the different dialogic processes, the kinds of knowledge
involved in those processes, and to generally gauge the nature of teachers’ participation in the
knowledge creation process.

To analyze my interview data, I applied a different coding scheme that included the topic
being discussed, the process involved [if when talking about practice or a change in practice the
teacher spoke of learning from experimenting (practice) or from talking with colleagues
(dialogue)], and to whom, if anyone, the teacher turned for advice or guidance with respect to
that topic. Topic nodes included guided reading/centers, Scholastic Reading Series, writing,
working with words/Words Their Way/spelling, independent reading/readers’ workshop, daily
oral language, reading for fluency, and Patricia Cunningham’s Four Blocks Model. Process
nodes included practice/experiment and dialogue with colleagues. This coding scheme allowed
me to trace each teacher’s practice with respect to the different components of her literacy
program over the course of the three years. For example, extracting all of the text from
interviews with Heather in which she talked about teaching guided reading allowed me to see the
trajectory of her guided reading teaching over the three years of the study, pinpointing how her
practice had changed and stayed the same as well as what she had learned and how.

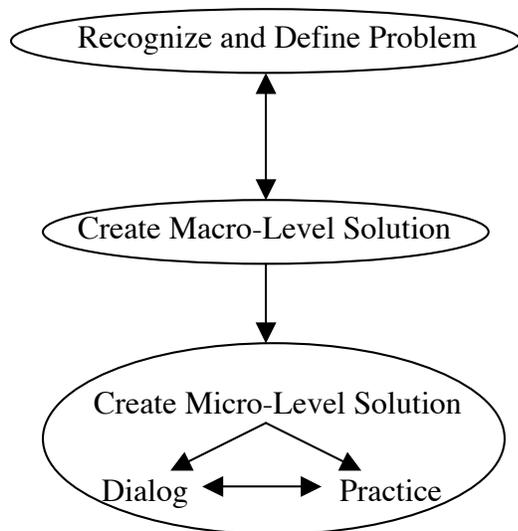
informed the coding process but I also used categories that emerged from the data to press on my theoretical frame. Using emergent patterns as the basis for asking more focused questions of the data, I further refined my coding scheme and analysis in an iterative process.

A MODEL OF TEACHER KNOWLEDGE CREATION

The Wayne teachers engaged in a complex and ongoing knowledge creation process that includes three major components as reflected in Figure 3.1: recognizing and defining a problem, finding a macro-level solution, and creating a micro-level solution through dialogue and practice. In the following sections, I will examine each component of the process in turn. I will then describe what the teachers learned as the result of their participation in this process.

Figure 3.1

The Knowledge Creation Process at Wayne Elementary School



Recognizing and Defining a Problem

The starting point in the knowledge creation process is recognizing and defining a problem that comes out of some aspect of accepted practice (Engestrom, 1999). At Wayne the starting point was a dialogue among district and school leaders, teachers, and parents about how to better support teaching and learning. At that time, the conditions for dialogue were ripe; stakeholders needed to address a demonstrated achievement gap between majority and minority students in the district and Wayne had experienced what the current principal described as a period of “turmoil”, with two interim principals in quick succession replacing a principal who had been there for 19 years. The current principal recounted that with the second interim principal,

Things kind of like went up for grabs....It was just...the whole environment. The kids weren't doing anything; the kids weren't learning. The teachers were fighting with each other. The teachers were fighting with the parents. They were fighting with the principal. The building was in a situation of shutdown and the teachers had given the principal the vote of no competence. So the principal was reassigned and then I was asked to come over here and settle things down and get everybody back on track. (Interview transcript, 10/05/00)

In addition to being plagued by turmoil, Wayne was often noted across the district and the wider community as being the district’s lowest achieving school. As the district Literacy Director explained,

Wayne has, as you probably have heard, a reputation of being the lowest achieving school. And, in fact, that's not true....Not only kids in sub-categories or groups, but also

by content area, you find that that's not the case. So one of the things we were trying 82 to do is to say, 'What do we need to do at Wayne to help people see that...it has a reputation it doesn't deserve on the one hand, and yet...it is a challenging school. It is our highest poverty school. So given that it's our highest poverty school and...the school with the highest mobility, what else can we do to support both teachers and kids and parents?' (Interview transcript, 03/09/01)

Wayne's relatively high proportion of low income minority students and its high mobility rate posed a challenge to district and school leaders who were grappling with a district-wide achievement gap between majority and minority students. The principal described the gap in academic achievement between African American students and white, Asian, and even Hispanic students as "a big issue here. It's a big issue in the district" (Interview transcript, 10/05/00). Increased attention to the achievement gap was due, in part, to the recent implementation of a state mandated high stakes accountability testing system which was helping to make the gap transparent to school and district stakeholders.

Thus, a sense of a need to get Wayne "back on track" along with increasing attention to the achievement gap led to a dialogue among school and district leaders, teachers, and parents. According to the Literacy Director, the literacy reform "originated in these discussions...which were all around this image of Wayne School" (Interview transcript, 03/09/01). Furthermore, she explained that the reform initiative

came about from a recognition that there was a new principal. There was a sense of the achievement gap being very evident there. So could we do some things differently to really make a difference in the district?...Initially our meetings with the teachers were...they needed some help. We were looking at what kind of help and could we figure out

what categories that help needed to fall into. And then really trying to get at the level 83 of classroom instruction. Not so much early intervention, not so much pull-out reading programs, but what can we do that really boosts what's happening in the classroom? Because we need to send kids into very supportive classrooms. (Interview transcript, 03/09/01)

The Literacy Director revealed that participants in those initial discussions defined the problem, generally speaking, as how to improve student achievement at Wayne by specifically targeting the classroom, given the salience of the achievement gap there. Current conditions provided the creative chaos (Nonaka, 1994) necessary to trigger a process of knowledge creation. Specifically, building-level turmoil that included feelings of “mistrust that something was going to be done to the teachers at Wayne” (Interview with Literacy Director, 03/09/01) along with a glaringly public achievement gap led to a series of meetings in which participants came together to define the problem and make sense of how to proceed. Wayne stakeholders realized they could no longer continue on autopilot. Instead, they worked to define the problem, essentially asking, what might account for the discrepancy between academic goals and student achievement? And furthermore, how might we proceed from here to solve the problem?

Creating a Solution

Creating a solution was a complex process that occurred at both the macro and micro levels. What I mean by a macro-level solution is a broadly defined set of goals that constitutes a framework for more specific subsequent action – the micro-level solution. In other words, the development of a macro-level solution precedes, and sets the stage for, specific actions that will be taken in the future in an effort to solve the problem. In the Wayne case, though teachers and

parents were involved, an outside expert played a primary role in developing a macro-level solution. 84

A micro-level solution on the other hand, is the specific strategies that participants create, implement, and tweak, on an ongoing basis, in order to carry out the macro-level solution. As this is more of a street level process, classroom teachers along with expert teacher consultants played a more central role in creating the micro-level solution. At Wayne, the development of a solution at both the macro and micro levels is significant to the knowledge creation process. I discuss each of these in turn below.

Developing a Macro-level Solution

Defining the problem and creating a macro-level solution were not mutually exclusive steps in a linear process. Instead, the problem and solution were worked out in a somewhat iterative process. Indeed, the starting point, as highlighted above, was leaders and teachers recognizing the broad problem of an achievement gap and a need to better support classroom teaching and learning. This recognition led to a discussion in which participants brainstormed ways they might be able to create more supportive classroom environments. The Literacy Director recalled that working toward a solution, “The teachers came up with a list and...there were 100 and some different suggestions of things that they wanted to see happen” (Interview transcript, 03/09/01). One key support the teachers asked for was a continued partnership with a nearby university. The district had partnered with Barbara, a faculty member from the university’s Reading Institute, having received a grant to design and implement the Fluency Program. One Wayne teacher in particular, who had received special training at the university’s Reading Leadership Institute and viewed her experience there positively, especially advocated

for a continued school/university partnership. In response, the Literacy Director approached 85 Barbara about helping the school to solve its problem:

I said, "We'd really like to do this [create a partnership] and I think we could really make this happen. Would you be interested?" And then they sort of negotiated with me what they were interested in doing. (Interview transcript, 03/09/01)

Barbara, it turns out, was interested in working on the literacy program at first grade and wanted to “try and bring three or four research...based instructional principles” (Interview with Barbara, 02/20/02) into the school. These principles included providing sufficient time for instruction, matching students to appropriately leveled reading materials, implementing a good word study component, and looking at alternative staffing arrangements in order to provide flexible small group instruction. The Literacy Director then went back to the teachers and said, “Here's how we can do this but it's a first grade thing and that's where we're going to start” (Interview transcript, 03/09/01).

With Barbara’s guidance, a macro-level solution began to take shape and was documented in Wayne’s Instructional Improvement Plan. According to the plan, the district would “establish a partnership with [the] university in order to create a demonstration site at Wayne School. This collaboration will enable the district to demonstrate that high levels of performance and achievement can occur for all students in a school with a large number of low-income students.” In particular, the partnership with the university would “offer intensive support for the reorganization of the first grade classrooms at Wayne. Focus issues will be use of time, classroom organization, matching students to materials, curriculum extension and compacting, and flexible grouping” (Wayne Instructional Improvement Plan, 1999).

Notably, in outlining a solution, Barbara further articulated the problem. She did not 86 cast it as just an achievement gap, but as specific dimensions of instruction that might be problematic. Highlighting the use of time, matching students to materials, and flexible grouping for example, Barbara suggested that the problem was more specifically one of insufficient time on instructional tasks and a failure to use materials and group students in the most effective ways. Hence, the solution Barbara devised pointed to a more highly specified problem. Interestingly, the solution itself helped to determine how the problem was specified. One can imagine how a different solution would have led to a different specification of the problem. (Imagine if the solution had been to adopt a scripted lesson format. Such a solution would have suggested that the problem was one of teachers having too much autonomy, for example). Thus, the way the problem was defined was somewhat dependent on the availability of a particular solution and the opportunity that the solution afforded. Moreover, Barbara, in playing a key role in devising a solution, also played a key role in further articulating the problem.

The beginning of the knowledge creation process, including the recognition of a problem, the development of a macro-level solution, and the further technical specification of the problem, is a key part of the process that in effect lays the foundation for knowledge creation. Nonaka's (1994) model of organizational knowledge creation leaves the recognition and definition of a problem as an unexamined black box. While he does argue that creative chaos is a condition that triggers the knowledge creation process and that problems are constructed from available knowledge, he does not offer any insights into how problems are constructed out of that chaos and by whom. Indeed, Nonaka (1994) states that the knowledge creation process begins with the "enlargement of an individual's knowledge" (p. 22), but he gives us little to go on in terms of what precipitates that process.

important phases of goal and problem formation. In his analysis of expansive learning, he argues that the cycle "begins with individual subjects questioning the accepted practice, and it gradually expands into a collective movement or institution" (p. 383). Although he stresses the importance of "object/problem construction in innovative learning" (p. 397), he limits his analysis to work teams, essentially insulating the work of those teams from the wider organization and beyond. He also does not address the conditions that precipitate the expansive learning cycle.

The Wayne case begins to fill these gaps in our understanding, shedding light on the very beginning of the knowledge creation process, in particular what triggers it, who is involved, and how it unfolds. First, the knowledge creation process began in response to conditions that made it difficult for the school community to continue its work as though nothing were amiss. Turmoil resulting from the school's turnover in leadership along with the achievement gap constituted an interruption to the school's ongoing work. As participants realized a certain subset of their students was falling behind, they switched from automatic to conscious processing in order to make sense of that interruption (Weick, 1995). That interruption to their thinking and their work began the knowledge creation process.

Second, the beginning of the process involved actors who occupy a variety of positions both inside and outside the school. District and school leaders, outside consultants, teachers, and parents came together to engage in a dialogue in which they began to define the problem. Recognizing and defining the problem was not limited to 'management' (i.e., district or school leaders), nor was it situated solely in the work of individuals at the street level (i.e., teachers). Rather, it was situated in a community of practice that emerged in response to a problem with which participants at all levels of the organization were concerned. The achievement gap was

not just on the minds of formal leaders, but on the minds of teachers and parents as well. 88

Though leaders, particularly Barbara and the Literacy Director, played a pivotal role in creating the macro-level solution and specifying the problem, the teachers participated in the process by sharing their ideas, actively seeking support from the university, and by giving the leaders license to take the lead. Viewing the knowledge creation process from a community of practice perspective, this case illustrates how the process began with the emergence of a community that came together to define and solve the problem. Furthermore, who participated in the community – people from both inside and outside the school and district – set the stage for a knowledge creation process that involved both inside and outside knowledge, a point I will address later.

Third, this case illustrates that solutions are opportunistic and can precede the articulation of problems. Participants at Wayne did not specify the problem and then create a solution to solve it. Rather, a solution (i.e., Barbara's proposal) became available in response to the general problem of an achievement gap. That solution specified the problem in technical terms. Indeed, Barbara's solution and the school's problem became coupled at a critical point (Kingdon, 1984), resulting in a tremendous opportunity for teachers to transform their practice.

The recognition and definition of the problem and the development of a macro-level solution marked the beginning of the knowledge creation process, setting the stage for the development of a micro-level solution, that part of the process in which community participants began the process of learning and changing their practice.

Developing a Micro-level Solution

Once stakeholders defined the problem and identified a macro-level solution, the Literacy Project, whose participants constituted a community of practice, was born. In the context of this community, participating teachers developed a micro solution – specific strategies they worked

to create, implement, and tweak on an ongoing basis – in order to carry out the macro solution. I will begin by describing the Literacy Project. I will then unpack the sub-processes through which project participants developed a micro-level solution. 89

Literacy Project

The initial purpose of the Literacy Project was to reorganize reading instruction at first grade in order to better support teaching and learning in the classroom. In its first year, (Year 1 of the study), participants included the four first grade teachers, three reading specialists, the school's speech pathologist, the District Literacy Director, Barbara, and Tamara and Ruth, two expert teachers who worked with Barbara at the university. Their plan that year was to create a reading program in first grade, and then to follow that cohort of first graders through second and third grade, working with the second grade teachers in Year 2 and the third grade teachers in Year 3. The initial project had several components. First, project leaders¹⁸ asked the school principal to create a block schedule so that the first grade teachers would have a two-hour block of time for uninterrupted literacy instruction. Second, they brought the school's reading cadre, including the three reading specialists and speech teacher, into the first grade classrooms for reading every day. This infusion of personnel allowed the first grade teachers to group their students into small reading groups by reading level, with each group receiving on-level guided reading instruction from either a reading teacher or the classroom teacher for 30 minutes every day. Third, project leaders wanted the teachers to develop a shared understanding of the various components of their reading program, including guided reading, shared reading, and word study, so that they would all be on the same page instructionally. Fourth, the project had a two-pronged leadership component. First, project leaders wanted Wayne personnel, and the reading

¹⁸ Project leaders are Barbara and the district Literacy Director.

specialists in particular, to take a more active role in providing leadership for literacy 90

instruction at Wayne. Second, to justify the infusion of resources at Wayne, the school was to become a demonstration site for the district, meaning that teachers from other schools would be able to come to Wayne to observe firsthand the fruits of the Literacy Project. In addition to these components, Ruth and Tamara provided regular classroom support by doing demonstration lessons in the first grade classrooms. Finally, all of the participants in the project met monthly.

The following year, the four second grade teachers joined the project. It is here where my account of the knowledge creation process continues. Guided by the macro-level solution that focused their attention on use of time, creative staffing, and the organization of reading instruction, the second grade teachers, together with the other participants in the Literacy Project, worked on a micro-level solution, developing, honing, and tweaking particular classroom structures and strategies to support literacy teaching and learning in the classroom. The second grade teachers developed a micro-solution through two mechanisms: dialogic processes and practice. First I explore the role of dialogic processes.

Dialogic Processes

In Nonaka's (1994) model, knowledge is created through the shared understanding of tacit knowledge (socialization) that, once explicitly labeled (externalized), is justified and incorporated into practice (internalization). Dialogue comes in to play in his model during externalization – that part of the process in which individuals use language to articulate their shared understandings of tacit knowledge (Nonaka, 1994). Through talk, they label and make explicit shared understandings that constitute new concepts.

The case of knowledge creation at Wayne presses on Nonaka's model in two interrelated ways. First, while Nonaka's model is very much focused on tacit knowledge, specifically on

enlarging individuals' tacit knowledge, developing shared understandings of tacit knowledge 91
in work teams, and conceptualizing those understandings in explicit terms that can be
crystallized, justified, and shared beyond the boundaries of the organization, I find that at
Wayne, explicit knowledge takes a much more prominent role in the knowledge creation
process. Knowledge was not created so much in teachers developing shared tacit understandings
of classroom practice, but through teachers' talk rooted in their explicit knowledge about
practice.

Furthermore, dialogue is a key mechanism throughout the knowledge creation process,
one that is not limited just to the articulation of tacit knowledge. Indeed, participants relied on
dialogue in defining the problem, in creating a macro-solution, and, as I will show, in creating a
micro-solution. Specifically, I identify three different dialogic processes that were used in the
creation of a micro-solution – interpretation, sensemaking, and combining explicit knowledge.
These processes, by virtue of involving talk in which individuals articulated ideas, were rooted in
explicit rather than tacit knowledge. I will examine each of these dialogic processes in turn.

Interpretation. In Chapter 2, I discussed how teachers constructed knowledge about math
teaching through a process of interpretation. I argued that when teachers converse with
colleagues or participate in professional development meetings, they encounter messages about
instruction that they interpret. Dialogue is a means of delivering messages that teachers
interpret, either by assimilating or accommodating them (Piaget, 1972). Learning about literacy
teaching was no different. The second grade teachers, while participating in Literacy Project
meetings and talking with project leaders, teacher consultants, and each other, exchanged
information, ideas, and observations that the others then interpreted. Through interpretation, the
teachers processed and constructed understandings (or potentially misunderstandings) of

messages about instruction. For example, in a professional development session for all of the 92 district's second grade teachers, the Literacy Director presented the latest research on guided reading instruction, including how to group students by reading level, how to choose appropriately leveled reading materials, and how to introduce and use those materials to accomplish the objectives of guided reading. Her presentation amounted to a series of messages about teaching guided reading that the teachers in the audience interpreted, processing them by assimilation or accommodation. Indeed, the Wayne teachers expanded their understanding of guided reading as evidenced in the changes they made to their own guided reading instruction. [I will provide a detailed account of these changes at the end of the chapter.] In short, they learned in part by interpreting the messages they encountered about guided reading.

Learning through interpretation was not limited to formal professional development sessions. Indeed, the second grade teachers, in talking with each other throughout the day at lunch, during common prep periods, and before and after school, shared ideas and tidbits from their own practice with one another, for example how their morning reading lesson went, their students' performance on a recent test, or a new activity they tried. These conversations also provided messages about instruction that they interpreted, with the potential for learning. Hence, interpretation was one dialogic process that contributed to the development of a micro-solution.

Sensemaking. As I also explained in Chapter 2, teachers sometimes encounter messages about instruction that they have difficulty interpreting. These messages interrupt their ongoing flows of experience (Weick, 1995), i.e., their practice or thinking about practice. Messages they perceive as interruptions to their understanding can cause teachers to switch from automatic to conscious processing in an attempt to make sense of them. Instead of accommodating or assimilating these messages through interpretation, they bracket them, or pull them out of the

conversation by questioning the sources of puzzling messages to engage them in further dialogue. 93

For example, as part of her presentation on guided reading to the second grade teachers, the Literacy Director explained that “Low kids have to be at the level that’s right for them” (Field notes, 10/11/01) for guided reading to be effective. In other words, the purpose of guided reading is to use materials at the level that most effectively scaffolds students’ learning to read. That level is not necessarily the student’s actual grade level. She further explained that *grade level* materials (i.e., the Scholastic Reading Series for which all teachers and students in the district are accountable) should be used for shared reading instruction so that all students are at least exposed to the grade level materials on which they will be tested. Marcia, perceiving the Literacy Director’s message as contradicting her own understanding of the relationship between instruction using leveled materials and assessment, questioned her further in an attempt to make sense of that discrepancy.

“How do we address the district assessment if we use Scholastic as the shared reading and we know that for a third or half of our kids it’s not on their instructional level? Is that [assessment] going to change?” Marcia asks. The Literacy Director pauses ever so slightly and says flat out, “No,” and explains that they still need a way to assess where students are and they can’t forget that their goal is to bring students up to grade level, even though they are teaching them from where they are for guided reading. Marcia presses, “It’s an issue,” but the Literacy Director adds that even the most struggling students “still have to take the Iowa¹⁹.” “Right,” Marcia says, and concedes that they do need standards. (Field notes, 10/11/01)

¹⁹ Iowa refers to the Iowa Test of Basic Skills, a standardized achievement test.

In this excerpt, Marcia perceived the Literacy Director's message as contradicting her 94 understanding of the relationship between differentiated instruction (and the different materials used to carry out differentiated instruction) and assessments. For Marcia, the Literacy Director's statement that teachers should use leveled books to teach struggling students and grade level materials to assess them did not make sense initially. This perceived contradiction led Marcia to engage in sensemaking by questioning the literacy director to engage her in further dialogue. In response, the Literacy Director clarified the logic of the policy, arguing that the Scholastic assessments do make sense in order to prepare every student for mandatory standardized tests as well as to ascertain how students are performing in relation to grade level standards. After this conversation took place, Marcia seemed to understand and accept the logic of using both the Scholastic Series *and* leveled materials to teach reading, saying,

The district still says that you have to use Scholastic as your main source for reading...I think at this point it's more because of the assessment that comes with Scholastic: it's given. Where if you went to completely guided reading groups of instructional books, there's no formulated, there's no consistent, across-the-grade-level assessment. With the Scholastic there's source book tests that are the same across the grade level...I think that's...the importance of Scholastic. (Interview transcript, 1/28/02)

This example demonstrates how teachers use dialogue to make sense of messages about instruction that they perceive as contradicting their understanding in some way. Engaging in sensemaking gave teachers the opportunity to construct understandings of puzzling messages. Sensemaking was another dialogic process through which the teachers developed a micro-solution.

dialogic processes that contributed to the overall knowledge creation process at Wayne, they are not unique to that process. Teachers can engage in these processes at any time, independent of an overarching process of knowledge creation. In their daily work, teachers encounter messages in their environment that they interpret, or if those messages interrupt their thinking or practice, that they may try and make sense of. The dialogic process that sets knowledge creation apart from this everyday, on-the-job learning is the combining of explicit knowledge. While Nonaka (1994) identifies combination as one of the four modes of knowledge conversion, it is conspicuously absent from his model of knowledge creation. On the contrary, I find combination to be a key mechanism through which teachers created knowledge.

Through talk, participants in the Literacy Project brought their explicit knowledge together – particularly the teachers’ inside knowledge of practice and leaders’ outside knowledge of research on literacy instruction – which they combined to create new knowledge. Rather than using dialogue as a means of articulating knowledge for others to interpret, participants used dialogue to actively combine their respective inside and outside knowledge to create a knowledge base that was grounded in research-based principles and yet situated in the local context, providing an important resource as the teachers worked to change their practice. The process of combining knowledge was fundamental and unique to the development of a micro-solution. Using data from the formal meetings in which the second grade teachers participated, I will examine in more detail the process of combining explicit knowledge.

The second grade teachers participated in over 14 meetings pertaining to literacy instruction in which they engaged in dialogue with colleagues and literacy experts. Four of these meetings were professional development sessions in the typical sense: led by experts who spent

the majority of time making presentations on the session's specified topic with some time 96 allowed for teacher questions and an occasional facilitator-led activity. Two of these sessions focused on how to teach guided reading, included all of the second grade teachers from across the district, and were led by the Literacy Director. The other two sessions, one for all of the Literacy Project participants and the other for the entire Wayne staff, focused on how to implement a commercial word study program called "Words Their Way." In these sessions, the teachers learned primarily through processes of interpreting the presenters' messages and engaging in sensemaking when messages interrupted their understanding.

The remaining ten meetings were more open-ended in that the time was used not just to 'teach' participants a specified instructional topic, but to do a variety of things. Some of these meetings involved all of the project participants (i.e., the first and second grade teachers, reading specialists, project leaders, and teacher consultants) while others were smaller meetings between the second grade teachers and the teacher consultants or project leaders. Unlike in the professional development sessions in which the teachers took a rather passive role, in the remaining meetings they took a more active, participatory role. In particular, through dialogue, project participants combined their explicit knowledge to develop, discuss, and reflect on instructional practices; to discuss and solve problems related to particular students; to plan, schedule, and coordinate instruction; and to reflect on the state of the project and plan for its future. The first three dialogic activities pertain directly to instructional practice and are of primary importance to the development of a micro-solution. I examine each of these activities in more detail below²⁰.

²⁰ The last activity – reflecting on the state of the project and planning for its future – is important for maintaining the viability of the project and is instrumental in ensuring that knowledge creation can continue. Although it does set the stage for knowledge creation, it is

discussing, developing, and sharing instructional practices. Furthermore, they discussed different dimensions of instruction during this time, including specific instructional tasks (particularly what to do and how with respect to guided reading, shared reading, writing, and working with words), materials (how to use particular materials), assessment (how to administer a variety of assessments and how to use the results), grouping (how to use assessments to group students for small group instruction), and classroom management (particularly how to implement learning centers as a classroom management tool).

Less than half the time spent talking about instruction (including all of the above dimensions) was presentational in nature. By presentational, I mean individual participants spoke without engaging others in a dialogue. This kind of talk included either teachers presenting detailed excerpts from their own practice as a way to give the group an idea of the kinds of instruction they were engaging in and how it was working (a ‘state of the classroom’ address so to speak), or leaders instructing the teachers, explaining what to do and/or how to do it with respect to instructional tasks, materials, assessment, and so on. The primary dialogic mechanism at play in these instances was interpretation, with teachers interpreting the messages being presented.

On the other hand, more than half the time participants talked about instruction, they combined their knowledge, adding, exchanging, questioning, and building on each others’ knowledge and ideas about practice to create a new kind of research-driven, contextualized knowledge. In one meeting for example, Heather shares a reading activity she has been doing in

secondary to those activities that pertain directly to the organization and delivery of classroom instruction.

her classroom and asks Ruth – one of the teacher consultants – how she might be able to make the activity more effective. 98

Heather: Now what I do three days a week...you can tell me if it's a good idea or not, is...they read to the class on the rug and they get to post questions after they read, and those who aren't comfortable get to choose a buddy so they're sitting up there on the rug together. And it's just a way to get...the oral speaking in, and getting them comfortable with holding books and reading. And the first couple [of them] were like, "Oh do I have to?" And now they love it by this time because everyone's gone. And so...they always ask the same questions- "Oh, what's the setting?" or "Why didn't-" you know, I had a kid ask today well, "Why didn't," you know, "this do this?" And I was like, "Wow!...A 'why' question!" But I was thinking about making that even richer for them.

Ruth: So you've got that time set aside time for that.

Heather: Yeah, so I don't really, so I'm trying to figure out how to work it, you know, better. I haven't read anything, on, you know, the kids reading to the class except for their writing.

Ruth: Right. One of the other things I really want to focus on with um, the kids that I'll be working with too, is that you preview the story really well. And a lot of times we talk about previewing and the kids go, "Okay, I previewed it." And really showing them how valuable that time is by looking at the title, thinking about what they already know and looking at the pictures, trying to get as many of those words on the tip of their tongue as they can. And that would be a neat thing to be able to see your kids pulling in. (Meeting transcript, 10/22/01)

In this example, Heather shares a reading activity she has been doing in her classroom and asks Ruth how she might improve it to make it "even richer" for her students. She admits that she has little knowledge of what the research says about students reading aloud to the class. In response, Ruth suggests that in addition to reading and asking questions about the text, Heather might have students preview the text, a potentially rich activity that addresses reading comprehension. Through dialogue, Heather and Ruth combine Heather's working knowledge of implementing this reading activity in the context of her classroom with Ruth's knowledge of the utility of previewing texts from the research literature on reading comprehension to create a new understanding of how to improve this activity in Heather's classroom context.

explicit knowledge, i.e., knowledge they were able to articulate. Specifically, they combined Heather's inside knowledge of practice with Ruth's outside knowledge of research on literacy instruction to create a new kind of knowledge that was somewhere in between inside/practical and outside/propositional knowledge. This new knowledge was informed by theory developed by researchers and yet situated in the local context.

Combining explicit knowledge was a key part of the development of a micro-solution. However, participants did not just combine teachers' inside knowledge with experts' outside knowledge. Teachers' also combined their inside, practical knowledge with that of other teachers to create new knowledge about practice. In one meeting for example, a first grade teacher shared in great detail how she used the story *A Snowy Day* to teach a shared reading lesson on the suffix, i-n-g. She gave a play-by-play account of how she structured the lesson by describing the different tasks that organized it (e.g., a strategy called 'the hidden word' in which students try to guess a word that has been covered in the book; having the class spell the hidden word together; and rereading the text with the newly uncovered word), the content areas those tasks addressed (reading comprehension, vocabulary, spelling, and fluency), and how students responded by sharing samples of their work from the lesson. When the presenter finished, Marcia asked her to clarify and further articulate how she planned this lesson:

Marcia: What came first, was it the book? Because you wanted to read it –

The presenter cuts Marcia off and says "Yes" but Marcia says, "Wait wait wait. And then I want to know about your skill. Did you want to read this book and then flip through the book [to figure out what skill to teach]? I'm trying to find out if I pick a book for shared reading is there a particular method to the madness? Did you decide on this book because you wanted this book and it went with your snowy week and then go through it and decided on the skill? Or is it a book you said, "I know it's got this i-n-g skill in there and I'm going to use"...

Presenter: No. I wanted it because it's part of my winter thing and now that I have a 100 big book of it I'm like, 'How great! I can stick this into shared reading.' And so I sat there one night and I went through the whole text and thought, "What can I focus on?" So it was like I taught this for seven years but I needed to put it into a shared reading lesson and focus on one thing. (Meeting transcript, 01/28/02)

Pressing the presenter to articulate whether she planned her lesson using the book or the skill as the starting point, Marcia asks her to make the process of planning shared reading more transparent. This example suggests that teachers not only create knowledge about what happens in the classroom, but around planning instruction and how to make decisions regarding what to teach. By explicitly seeking the presenter's inside, practical knowledge of how to plan shared reading, Marcia combines that with her current knowledge of shared reading in order to expand her understanding.

In sum, the second grade teachers engaged in dialogue about instruction, combining their own explicit knowledge with that of other teachers and leaders as they worked to create a micro-solution and transform their literacy instruction. In addition, they engaged in dialogue to discuss and solve problems related to students.

Students. Participants spent 22% of meeting time discussing students. Roughly 60% of this talk was teachers making observations about students, both observations about students more generally as well as statements about particular individuals. For example, on several occasions, participants commented on the first and second graders' overall difficulty with vocabulary and their lack of exposure to rich experiences which form the basis for writing in school. On other occasions, teachers gave status reports on particular students, for example, the reading specialist sharing the names of students who passed out of reading recovery or teachers sharing difficulties or successes particular students were having in reading. These kinds of statements were mostly informational.

informational, but used to solve problems related to teaching particular students. Rather than just stating how students were doing, this kind of talk involved the combination of different participants' knowledge about students, including their particular learning problems, and of potential solutions. Barbara often began meetings by asking teachers to report on any difficulties they were having with individual students. On several different occasions for example, Karen brought up difficulties she was having with one of her second graders. Many of the Literacy Project participants were familiar with this student, having worked with him in the past. Together, those who were familiar with him were able to combine their knowledge to create a more holistic understanding of his strengths and weaknesses. In the following excerpt, Karen shared her concerns:

Karen: I have one more. Elijah is a very fluent reader but his comprehension is so low. He has no problem decoding...like you said with LD, the one day he'll have something and the next day he doesn't at all...that's him.

Marcia: He's a beautiful reader. I couldn't believe it. He has no comprehension.

First grade teacher: He knows his spelling.

Karen: His spelling is awesome...No he doesn't need spelling...He's very strange.

Linda [first grade teacher]: I really believe that it's an emotional issue.

Karen: Oh definitely.

[A lot of teachers are familiar with Elijah and his family. Someone says that nobody has ever paid any attention to him.]

Linda: They dislike him at home....They didn't send him to kindergarten.

Karen: He's flat. No emotion.

[Barbara asks if they think he would benefit from some tutoring or from something else. They discuss the possibility of finding someone to work with him one-on-one.]

Renee [Elijah's first grade teacher]: He wants your respect....That's all. He just asks 102 that you respect him and you give him that respect. Then he's all yours.

Linda: You know what he needs? He needs a man.

[Others agree.]

Karen: You know, they're trying to get him a mentor. They're trying to find a mentor for him. Kind of like Big Brothers.

[They talk about what qualities they are looking for in someone to work with Elijah.]

Barbara: So what are we looking for? What kind of person are we looking for?

Renee: We're looking for someone that will take an interest in him but not be a pushover...who will give him the respect....A black male is what he needs....Someone who will see him in the neighborhood. (Meeting transcript, 01/28/02)

Individual teachers had explicit knowledge about this student stemming from their own experiences with him. Through talk they were able to pool that knowledge to create a more holistic picture of his strengths and weaknesses. Specifically, Marcia commented that he is a "beautiful reader" but has "no comprehension", a first grade teacher and Karen added that he "knows his spelling," and Linda concluded and others agreed that his problems are largely "emotional." Armed with a more holistic understanding of this student, and particularly that his problems seem to be more emotional than cognitive, the teachers then devised a solution – to find him a tutor who will offer him support and respect. Through conversation, the teachers pooled their knowledge to define the problem. In pinpointing the problem, a logical solution emerged. This conversation is representative of those in which together, the participants tried to solve problems related to teaching particular students.

The development of a micro-solution involved teachers learning how to teach literacy to the most challenging students. One way they accomplished this was to combine their knowledge about particular students in order to devise targeted strategies to help them.

knowledge about instructional practices and students, but also to plan, schedule, and coordinate instruction. Participants spent 20% of meeting time discussing the logistical aspects of teaching literacy, including scheduling the various components of literacy instruction and how to use available staff and tutors. The literacy program was complex in that it included small-group, leveled guided reading instruction (using resource teachers as well as classroom teachers), shared reading instruction using district mandated Scholastic materials, fluency tutoring for select students (using volunteer tutors), writing instruction, self-selected reading, and word study. In addition, the teachers were subject to the goals of the Literacy Project, including providing the lowest performing students with multiple hits²¹ of guided reading every day and devoting more time to writing, all of which affected the way teachers structured their instructional time. Fitting all of these components into a two hour literacy block each day, punctuated by taking attendance, bathroom breaks, and gym classes, was challenging to say the least. This complexity helps to explain why they spent one-fifth of their meeting time talking about scheduling and logistics. Furthermore, reading instruction was now under the purview of not just the classroom teachers but of support staff who were coming into their classrooms. Hence, the teachers also talked with assigned support staff to coordinate when they would come into the classroom and with which reading groups they would work.

The teachers' work on the logistics of implementing a new literacy program was ongoing, a topic of conversation throughout that first year of their participation in the Literacy Project. Indeed, one entire meeting was devoted to the subject. In that particular meeting for example, the Literacy Director sought information about the teachers' current schedules while presenting a

²¹ A 'hit' is a period in which a student receives instruction. Project participants often talked about the need for struggling students to get multiple hits of reading instruction every day.

prototypical schedule that mapped out all of the literacy components. She began the meeting 104 with some fact-finding about the teachers' current schedules.

Literacy Director: I know you're going to have to do attendance. I know you're going to have to do that kind of stuff....The kids come in at 8:20, correct?

Marcia: Right. But the late bell rings at 8:30 so they get ten minutes to come in and get settled.

Literacy Director: Okay. So do you usually get those housekeeping kinds of things done between about 8:20 and 8:30 or is it really at 8:30?

Marcia: No, it's 8:30 to 8:45.

Heather: The kids show up until 8:45.

Literacy Director: Yeah, but you can be done with it...Right?

Heather: Yeah, well kids, if kids come in [on time] which is pretty...

Literacy Director: So the reality of it is, 8:45. So what are you going to do between 8:30 and 8:45 for the kids who are here?

Marcia: That's when I've always done the daily stuff [referring to daily oral language activities].

Heather: [That's when I do] journal writing.

Marcia: It could be SSR [Sustained Silent Reading] time, but I, I actually prefer the, the daily dailies because I think they get more out of it than they do the SSR [first thing].

Literacy Director: Well it depends on, it depends on what we're doing. I mean. I would...do the dailies differently...

[Following an aside about using the 'dailies' (Daily Oral Language), the Literacy Director continues discussing the schedule.]

Literacy Director: We're really looking at schedule, we're looking at additional help in the classrooms where we can get it. So if we look at this schedule, then instead of it being 8:30 to 9, the reality of it is, 8:45 to 9. [If] we can actually do some demonstrating, that's when we would do that.

Marcia: Okay, by demonstrations, people coming in and doing a mini-lesson? Okay.

Literacy Director: Or it might be coming in and if what you want to do is...get some familiar reading as opposed to SSR, then getting that set up. (Meeting transcript, 12/04/01) 105

This excerpt is just a small part of a lengthy discussion about the teachers' schedules. In it, the Literacy Director sought information about the teachers' current schedules to get an idea of the context in which they were implementing the components of the new literacy program. At the same time, she presented a prototypical schedule which mapped out all of the literacy components over the course of a week so that the teachers could see how a balanced literacy program is organized. Together, they combined the knowledge codified in that prototypical schedule with the teachers' current schedules to create a schedule for balanced literacy that would work in the context of the teachers' current classrooms.

Not only did they create knowledge in the form of a workable schedule, but also in terms of their understanding of how to prioritize instructional time. The use of instructional time was one of the original research principles on which the Literacy Project was based. The schedule the Literacy Director presented reflected the kinds of literacy activities that research has shown to be effective in the classroom, specifically guided reading, shared reading, independent reading, and word study activities. In the above excerpt for example, the Literacy Director, in presenting the sample schedule, suggested that the teachers' morning time would be better spent doing familiar reading²² rather than the Daily Oral Language activity they were already doing. How she allotted time in the schedule to the different literacy components – in this case carving out time for independent reading at the expense of more skill-based activities – signaled to the teachers the relative importance of various activities, according to the research. The schedule also

²² Familiar reading is a subset of independent reading for which students read independently, but only books with which they are familiar and have demonstrated that they can read on their own.

suggested that the teachers work with their lowest reading groups every day but work with 106 their middle and high reading groups only two to three times a week. This feature of the proposed weekly schedule suggested that the teachers should allot more time for guided reading with their struggling students than with their more capable readers. Hence, while combining their knowledge to create a new schedule, the teachers also expanded their understanding of how to prioritize instructional time.

So far I have illustrated how the Literacy Project participants engaged in dialogue that enabled them to combine their explicit knowledge to create new knowledge about instruction, to solve problems related to teaching particular students, and to create a schedule that could accommodate all of the literacy components about which they were learning. The combination of knowledge played a fundamental role in the creation of a micro-solution; the knowledge they created in this way formed the basis of the new literacy program. Combining knowledge through dialogue was not the only mechanism involved in the development of a micro-solution, however. Another key mechanism was practice.

Developing a Micro-solution Through Practice

Teachers translate knowledge, often created through dialogue with leaders and colleagues, into concrete practices, while continuing to develop that knowledge. They do this by observing others in practice and by experimenting in their own classrooms. At Wayne, the teachers developed knowledge by observing Ruth and Tamara teach weekly demonstration lessons in their classrooms. Throughout the school year for example, Ruth worked with the teachers to implement a readers' workshop, teaching a demonstration lesson earlier in the week with the teachers teaching a follow-up lesson later in the week. By observing Ruth teach and by teaching alongside her, the second grade teachers learned new ways to structure instruction (e.g.,

using a ‘readers’ workshop’ format), new strategies (e.g., particular activities such as previewing texts), and the use of new instructional materials (e.g., leveled books, graphic organizers, and so on). 107

All of the teachers reported learning a great deal from observing Ruth and Tamara in practice. Marcia noted that “Ruth and Tamara have been the major determinates of what I've done in this classroom this year in terms of reading and writing” (Interview transcript, 05/30/02). Reflecting on Ruth’s demonstrations, Karen concluded, “The best way for a teacher to learn is to see another teacher doing it. I think that is the best” (Interview transcript, 03/13/02). Sondra concurred,

Now I can't say enough about the two of them [Ruth and Tamara]. That has been the most worthwhile thing of this whole [project].... You know, as long as they're doing it and you get the action, well then you get more out of that. And then plus... I'm participating. (Interview transcript, 12/05/01)

Ruth’s and Tamara’s demonstration lessons were an important mechanism for the development of knowledge. By observing them teach and by practicing using new structures, strategies, and materials, the classroom teachers were able to experience that knowledge in practice.

Additionally, these demonstrations and experimental practices became the subject of future dialogue in project meetings in which Ruth, Tamara, and the classroom teachers shared their experiences and discussed what they learned with the other participants. Thus, excerpts from teachers’ practice provided the ‘stuff’ for those dialogic processes described earlier that contributed to the knowledge creation process.

In Nonaka’s (1994) model of knowledge creation, once participants articulate their shared tacit understandings in the form of new concepts, they crystallize those concepts into some

“concrete ‘form’ such as a product or system” (p. 25). At this stage, the central mode of 108 knowledge conversion is internalization at a collective level, which is “facilitated by encouraging experimentation” (pp. 25-26). Indeed, an important part of the knowledge creation process at Wayne was to experiment with knowledge the teachers created through the dialogic processes outlined earlier. So, for example, earlier, when Heather asked Ruth how to make a reading activity more “rich,” and Ruth suggested that she have students preview texts, Heather then experimented with that new knowledge in her classroom, testing it out in practice.

However, at Wayne, this facet of the knowledge creation process differs from Nonaka’s (1994) ‘crystallization’ in two ways. First, due to the nature of teaching as a private practice, experimentation was often enacted by individual teachers in their classrooms, not by formal groups or departments. Hence, concepts could be applied in different ways, depending on the disposition of the teacher and the particular classroom context. Heather, for example, described how she had to learn a whole new reading program, by reading source materials and trying things out in her classroom:

What I did last year is totally different from what I'm doing this year. I have to learn a whole new program...I keep lugging books home again because now I have to take these books and learn this and, you know, I'm a trooper. After a couple months with guided reading I flopped and saw what worked and what didn't and went back and revised it. I think it's coming along well now after all that you know. (Interview transcript, 05/07/02)

Heather’s comments reflect the individual nature of her experimentation. Her experiment with guided reading allowed her to see “what worked and what didn’t” in her own classroom, the results of which, given her knowledge and beliefs and unique classroom context, differed from those of her colleagues. Indeed, each second grade teacher implemented guided reading a little

differently. Seeing what “flopped” in her own classroom allowed Heather to tweak her practice, tailoring instruction to fit the classroom context. Furthermore, Heather’s experimentation is a kind of retrospective sensemaking (Weick, 1995). She experienced an interruption to her practice (i.e., that guided reading “flopped”) and took active steps to make sense of that interruption by going back to the drawing board, trying new things, and making necessary changes. 109

Second, Nonaka (1994) portrays experimentation (crystallization) as a specific stage in the knowledge creation process. The Wayne case suggests that rather than a stage in the process, experimentation, like dialogue, is a mechanism through which teachers developed a micro-solution. Experimentation and dialogue were ongoing and often mutually reinforcing, twin mechanisms through which teachers developed knowledge. The teachers created knowledge through dialogue, continued to develop that knowledge by experimenting in the classroom, and then shared what they learned, expanding that knowledge even more, in subsequent dialogue. Or they developed new knowledge in the classroom and expanded that knowledge in sharing it with colleagues. Therefore, the teachers did not necessarily internalize new concepts, in some kind of “concrete” and fixed form, through experimenting. Rather, through experimentation, their knowledge continued to expand, grow, and change, as part of an ongoing process of developing a micro-solution.

For example, in an ongoing experiment with learning centers as a classroom management tool, not only did Marcia continue to develop knowledge about centers, but she shared that knowledge with her teammates so that everyone learned from her experiment. The teachers’ new focus on small-group guided reading instruction meant that students who were not receiving instruction from the teacher during guided reading time needed to engage in an independent

instructional activity. To implement guided reading in her classroom, Marcia experimented 110 with learning centers as a way to engage the remaining students while she worked with a guided reading group. Though the idea of centers was not new, the teachers were re-introduced to it during the district guided reading workshops. Anxious to get guided reading off the ground in her classroom, Marcia decided to hit the ground running in terms of centers:

Today I just, because I have the luxury of a student teacher, because I have the luxury of 16 kids who are very cooperative and eager, we gave it our all. We started with 4 centers today....And we gave a very short scenario of the 4 centers and we said, "You know what? Let's just jump in and try it." And they literally had ten minutes at a center....Friday we'll try a run through with Miss Andrews [student teacher] at the computer [and] me doing a guided reading group. But we might flip, and then leaving the other kids at the centers and see what happens. (Interview transcript, 10/17/01)

The first time Marcia experimented with centers in her classroom, she concentrated on getting four different centers off the ground rather than using that time to do guided reading. Her comments above illustrate the experimental nature of her approach to centers, suggesting that she would implement the centers in different ways to "see what happens."

Several months later however, Marcia admitted that maybe her approach to implementing centers had been misguided because it became clear that second graders need more time to learn the center routine:

What I've done is instead of having kids go to maybe three different centers, I've given the kids a particular center activity, but then they're all working on that center activity and I'm reading with one guided reading group. So I've just, I've pulled back and pulled in the structure a little bit and tightened it up. So they're still doing what they would do at

a center, but we're all doing one center at the same time. Which I really think is how 111
we'll start out the year in the fall....And I think part of the problems I had with
management is that we did not spend enough time doing one center at a time until kids
knew what the expectation was...because if you read up on centers and what to do they
talk about the fact that start with one; do it over and over and over again until you do it
well. And do that as an all group activity so everyone knows their expectation and then
move on to another one. (Interview transcript, 05/30/02)

In the act of experimenting, Marcia created knowledge about what works and what does not
work with respect to implementing centers. She did not internalize the center concept in some
fixed, concrete form, however. Instead, her knowledge continued to expand as she
experimented. Moreover, the failure of centers to meet her expectations led her to engage in
sensemaking. When the center process started to break down, she actively tried to make sense of
what was causing the problem and how she might fix it. In the end, the knowledge she
developed about centers through experimentation formed the basis of subsequent dialogue with
her teammates so that they also learned from her experience. Referring to Marcia's experience
with centers, Heather explained,

Marcia had started really early with hers [centers] and we all thought that was great at the
beginning because it was like, "Oh gosh, she's up and going!"...But it's falling apart. And
so whereas I came in and I eased my kids into it and we started doing centers that were
already familiar...we would all do one center together and it would take a long time and I
would familiarize them...And it seems to go much better. And so knowing, just
capitalizing off that with her experience, I'm like, next year I know to take it slow; just do

one center at a time and don't meet with the group while they're in the centers...the 112
freedom to them is too much. (Interview with Heather, 05/07/02)

Thus, the second grade teachers learned not just from their own practice but from their teammates' experiences as well.

In sum, practice, like dialogue, was a key mechanism through which the teachers developed a micro-solution. Observing experts teach, experimenting with new concepts in their own classrooms, and learning from their colleagues' experiments, the teachers expanded their knowledge of literacy instruction. In addition, experimentation was not a stage in the knowledge creation process, but rather a mechanism that continually came out of and also fed into teachers' dialogue about practice as teachers worked to develop a micro-solution. Hence, knowledge did not become "fixed" as a result of experimentation, but rather continued to develop.

What Teachers Learned

Now that I have explained the process of knowledge creation, it is imperative that I discuss what the teachers learned from participating in this process. From Year 1, the year before the Literacy Project began at second grade, to Year 3, the second grade team's second year of involvement, the teachers learned a great deal, as reflected in the variety of changes they made in practice. The bulk of these changes are related to the delivery of reading instruction and the use of reading materials, though the teachers also made changes to writing instruction and word study/spelling instruction. I will describe each of these changes in turn and provide evidence of them from teacher interviews²³.

²³ I should note that the teacher interviews on which these findings are based followed observations of their teaching. Thus, the interviews were based on what I observed in practice.

Delivery of Reading Instruction

Most of the changes the teachers made are related to reading instruction. One key change was the shift from whole class reading instruction using the district mandated reading series to small group guided reading instruction using leveled reading materials. In Year 1, Heather, Sondra, Marcia, and Karen all reported teaching reading predominantly to the whole class – with limited small group instruction – using the Scholastic Series as their primary materials. By the middle of Year 3, Marcia and Karen reported doing small group on-level guided reading instruction five days a week, Heather reported doing it four days a week, and Sondra reported doing it three days a week. By small group, on-level guided reading I mean teaching reading to students grouped together by reading level using books at their specified level. The teachers spoke of the logic of matching students to materials in a small group setting. Describing this change in her practice Karen said,

With the guided reading and the leveled books, having kids reading different things at their level; where before we were all reading from Scholastic. And that was, that's probably the best change. That makes the most sense. And having, you know, we're gonna have a lot more materials too to do that. It's a lot more labor intensive but it makes so much more sense. The kids, you can see them progressing because they're more engaged because they're at, doing what's right for them at that time. That's working.

(Interview transcript, 05/22/02)

Similarly, Heather commented,

Mainly the guided reading has come about because if, you know, and I've never thought about it this way, I was busy spending all this time last year working with kids and

having them do things that was not on their level. So how can kids achieve success 114

when it's not on their level?...And so that's the idea behind guided reading it's, "No, we're not gonna push everybody along the same way but we're gonna start you at your level and build on that and hopefully you'll all end up at the same spot at the end of the year."

(Interview transcript, 11/14/01)

The practice of matching students to appropriately leveled materials for reading instruction was a change that made sense to the teachers. A byproduct of this practice was the teachers' increasing reliance on individual assessments so that they could ascertain students' reading levels for reading group placement and also to track their individual progress. The teachers expanded their repertoire of assessments to include not just those assessments that were part of their reading series, but assessments they could do 'on the spot' in the classroom such as running records, fluency snapshots, and the DRA (Direct Reading Assessment). Indeed, the teachers received professional development to learn how to administer the fluency snapshots and the DRA, and henceforward used them on a regular basis.

Despite guided reading's new-found fame as the cornerstone of the teachers' literacy program, they were still held accountable to teaching the Scholastic Series to all of their students, even though the level of some of its stories was too high for some. Hence, while adding small group on-level reading instruction to their schedule, they also changed the way they approached the use of the Scholastic Series. By Year 3, both Marcia and Karen were teaching lessons on the Scholastic Series to the whole class in addition to daily guided reading instruction while Sondra was splitting her reading instruction each week between the two – doing small group on-level guided reading instruction three days a week and whole class Scholastic lessons the other two days.

teach reading in Year 3 than in Years 1 or 2, meaning that students were reading more on-level books over the course of a week rather than spending a whole week on one story out of the Scholastic Series. Sondra reported, “I’m using more, instead of just sticking to the Scholastic, I’m using more books with them. More of the literature books. I’m using more of that this year” (Interview transcript, 02/06/03). Similarly, Marcia said,

The other thing is for my lower end group, that I’ve done this year that I didn’t do last year, is, and this was through [the] Literacy Director’s guided reading workshop; they should be reading, you know, a new book every day, or every other day. And so, that I’ve been getting done. Three or four books [a week]. (Interview transcript, 02/10/03)

Not only did the teachers change the way they structured reading instruction by adding small group guided reading instruction, and the way they used materials by matching students to leveled materials and having them read more books, but they also incorporated new strategies into their reading instruction. For example, the two veteran teachers of the group, Marcia and Sondra, both spoke of retiring the antiquated practice of ‘round robin reading,’ in which individual students take turns reading passages aloud in front of the whole class while their classmates follow along in the text. Both teachers replaced this practice with one demonstrated in the guided reading workshops in which the teacher listens to individual students read out loud in a small group while the other students in the group continue to read to themselves. Both Sondra and Marcia described this change:

I basically did what they call round robin. You know, where you sit with a group of kids and one child reads and the others [are] supposed to be reading along. And the way I did, the way I do it now because one thing, and it’s true with round robin, you can have one

child reading and everybody else is, you know, doing their own thing and they're not 116
paying attention. But this way if everyone is reading the book and then I come around
and say "Okay, you read out loud," I still have the others reading. (Interview transcript,
12/05/01)

Similarly, Marcia revealed,

What I have done is even when I have children working in a small group, I still wanted to
hear all the kids read. So if I had four kids around, we would still take turns reading. Now
after workshops I went to last year and having the kind of class I have this year I'm
willing to take that leap and say, "Okay. I can sit and listen to Amy read while Kristen
and Sondra are still re-reading on their own." And so that's the only difference. Saying to
myself, "You can key in on one kid while the other kids are still re-reading the same
passage." And it's okay for them to keep reading that same passage. (Interview transcript,
10/17/01)

In light of the Literacy Project's emphasis on making the best use of instructional time, this
change in practice suggests the teachers were aware that round robin inevitably led to idle time
for students who were not assigned with reading aloud. In this case, Marcia and Sondra
engaged in a process of unlearning, or moving away from a practice that had not proven to be the
most effective. Striving to increase instructional time on task, they replaced it with a strategy for
which all students spend the allotted time reading.

In addition to replacing round robin, all of the teachers described using new strategies
that they had learned from their participation in the Literacy Project or related professional
development. For example, Karen described a strategy she started using to help develop her
students' inferencing skills and reading comprehension.

For example, I'm reading Pippy Longstocking to the kids. And because of how important she [professional developer] said inferring and picturing things in your mind [is], I had them all draw a picture. I often just go around giving [them] a little piece of paper and have them just draw a picture about what's happening, what I'm reading....And that's just a real simple thing....Oh it's wonderful to see the pictures they draw....She talked a lot about inferring and how that, that if they can't infer, I mean for comprehension that that's really a necessary thing. And it works really well with read-alouds....They're a lot more tuned in and interested to what I'm reading, even kids who usually aren't. (Interview transcript, 03/13/02) 117

In this particular example, Karen describes implementing a strategy to work on students' inferencing skills. She demonstrates not only how she executed the strategy, but also an understanding of what the strategy accomplished, namely to help students to make inferences, a skill that is key for reading comprehension. All of the teachers described new strategies they learned, from providing visual cues in addition to auditory cues for students by writing down difficult words from guided reading books, to giving students post-it notes so they can write down questions or make notes while they read a book, later sharing them in a group discussion, to using a graphic organizer called the "four quadrants" to explicitly teach students the four-pronged structure of stories – characters, setting, problem, solution. Thus, not only did they change the way they organized reading instruction and their use of materials, but also the ways in which they facilitated instruction.

Finally, one change they made with respect to reading instruction is their approach to self-selected independent reading (sometimes referred to as sustained silent reading). The logic of matching students with appropriately leveled materials for guided reading instruction carried

over to self-selected reading time. Whereas in Year 1 students were free to pick any book off 118 the shelf for self-selected reading, by Year 3 the teachers had arranged for students to read only those books at the appropriate level – so-called just-right books. Describing this change Marcia said,

Have they had silent reading time? Yes. Have they had books that were available to them? Yes. Did they call them “just-right” books? No. Did we make it more apparent that the only books you should be reading are ones that are on your instructional level? That was different this year. Last year, if you picked up a book, okay, you picked up a book. Now we said, “You know what? That may not be the right book for you. Let's do a quick running record. Let's see if it is.” And really getting them to self evaluate where they're at and to pick appropriate books that they can read on their own. (Interview transcript, 5/30/02)

Similarly, Karen spoke of this change very positively,

This has been a wonderful, wonderful thing where they each have a bag with books; their just-right books....I think it'll help a lot. I was trying last year, I mean, I had different baskets of books where I would have all different levels in a basket and then the group would have those books to choose from. And that worked better than before where I didn't really have any system and they just, I'd just say, “Okay, it's silent reading time. Find a book.” That was an improvement. But this is a big improvement....I love this system....And it's different. The whole silent reading time is much more different....Even kids that are hardly ever on task have been sitting there reading. (Interview transcript, 03/13/02)

While the changes teachers implemented were largely associated with reading instruction, they also made changes to writing instruction.

Writing Instruction

The biggest change all of the teachers made with respect to writing instruction was devoting more time to it, in keeping with the principles of writers' workshop, which they had learned from Tamara's demonstrations. In Year 1, the teachers were haphazardly squeezing in short periods of writing whenever they got around to it. By Year 3, all of the teachers were doing writers' workshop during regularly scheduled, longer periods. Largely due to their participation in the Literacy Project, the teachers elevated the status of writing instruction to earn a dedicated spot in their schedule. Referring to her writing instruction before participating in the Literacy Project, Sondra said,

My writing was almost hit and miss. This way they are, it's a concentrated, solid block of time that they are writing. Before we may get in maybe about 10 minutes, 15 minutes. But, I mean these children are writing for about 30 minutes. They're actually sitting there writing. We model; she's [Tamara] taking books, she's giving all kinds of examples and they actually have to sit there and write. And they have come up with some really good stories and some really good writing. (Interview transcript, 05/16/02)

Similarly, Marcia said,

Tamara would come in and we'd spend an hour and a half on that writer's workshop; the kids wrote. And when I was trying to do it last year and it was 30 minutes every day, we would just get started and we were through because we had to move on to the next subject area or the next block from Pat Cunningham. And so being given permission to say, "They have to do this well; we're gonna take the time to do it," I think has made the difference. (Interview transcript, 5/30/02)

In addition to devoting more time to writing instruction, the teachers experimented with the anatomy of writing instruction, implementing strategies that Tamara demonstrated in their classrooms such as modeling how to “hook” the reader by writing good opening sentences, using different kinds of graphic organizers to help students organize their thoughts before they begin writing, or using samples of student writing in ‘mini-lessons’ to demonstrate principles such as writing with details. By Year 3 however, writing instruction was deemed still a work in progress. While Marcia spoke of her plan the following year to expand writing from two days of writers’ workshop each week to writing every day, Karen and Sondra described wanting to change their whole approach to the subject because they were unhappy with the outcome of a particular unit Tamara had done on persuasive writing. Karen explained,

Well, the writing instruction [sigh], we're kind of having a hard time with that. We feel like we're getting a lot of good strategies, but they're, they're kind of not in a, a good order; that the kids are lacking....I mean, a lot of kids can't even write a good sentence and we kind of felt like, especially when we're doing this persuasive with five paragraphs, that that was way too, way too much, for even...some of my top kids....So, that's been kind of a problem. We talk about that a lot....We've talked about it with her [Tamara], and I think Heather was just talking to her today about it. Um, and I think that, next year I'll be doing writing differently. I really think I'll use a lot of her strategies, but not until they're ready for them. Not until they're at that point, because she's got, she's got wonderful strategies. They just don't make sense for a lot of the kids that aren't ready.

Just, they get frustrated. (Interview transcript, 02/03)

In addition to making changes to their reading and writing instruction, the teachers also changed their approach to word study (i.e., spelling).

Word Study

In Year 1, the teachers used Patricia Cunningham's Four Blocks model to structure their literacy instruction, dividing their time among guided reading, shared reading, writing, and word study. Word study involves spelling, phonics, and vocabulary. In Year 2, the leaders of the Literacy Project invited a teacher from another school in the district to introduce the participants to a developmental spelling program called Words Their Way. Developmental spelling follows the logic of guided reading in that students are grouped together according to their demonstrated spelling ability and given words to work with at the appropriate level. In addition, the Words Their Way program specifies different activities every day of the week using the words, such as sorting words into 'families' or by beginnings and endings. Though they did receive professional development for Words Their Way in Year 2, the teachers did not begin to implement it until Year 3. In fact, in Year 2, due to their intense concentration on reading and writing instruction, Heather (the newest teacher) was doing no word study at all, and Sondra and Marcia reported that their word study had faded over the course of the year. Only Karen reported keeping up with it on a regular basis.

By the middle of Year 3 however, all of the teachers were implementing Words Their Way, to some degree, with the help of an expert teacher whom the Literacy Director hired to assist the teachers in implementing the program. Specifically, Heather, Karen, and Marcia reported using the program on a regular basis, while Sondra admitted that some of the weekly activities included in the program had "fallen by the wayside" (Interview transcript, 02/06/03) in her classroom, primarily due to time constraints. All of the teachers spoke positively about the program. Karen reflected, "I like things that are leveled because...there's such a variety of kids.

I mean, it just makes a lot more sense than teaching them all the same thing” (Interview transcript, 02/03). Marcia, after scoring a recent Words Their Way assessment and seeing positive gains for the majority of her students said, “I think the program works. It's been a much more meaningful spelling program than I've encountered in years” (Interview transcript, 02/10/03). 122

In sum, the teachers made sweeping changes to their literacy instruction over the course of three years. The learning and change that was required of them was not easy, nor were proposed changes always met with open minds and open arms. While the teachers embraced many of the changes, as challenging as they were, they continued to resist one change in particular – retiring Daily Oral Language.

Daily Oral Language

Prior to their involvement in the Literacy Project, all of the second grade teachers incorporated Daily Oral Language (DOL) activities, traditional skill-based worksheets on grammar and phonics, into their daily schedules. Sondra explained that by doing DOL,

I'm covering a lot of skills in a short amount of time....We deal with, like I said, correct usage, which words, rhyming words, different things like that. So I do that every morning. I'm covering a variety of grammar skills. So...my main objective for that was hopefully that some of these skills will carry over in their writing. That when they write they will begin with a capital letter and that they will use...proper noun/verb agreement, and that they will know the punctuation that they should use. (Interview transcript, 01/31/01)

Marcia agreed that although “it practices the basic punctuation skills that the kids still have not completely mastered” and is “still very vital and important,” the DOL is “a time management

tool first of all. Because the kids come in and...it's a routine that they can learn quickly, that 123 they can do independently, and it allows the teacher to take care of the 20, the 15 to 20 minutes of paperwork every morning” (Interview transcript, 01/28/02).

The teachers viewed DOL as both an opportunity for students to practice grammar skills and as an independent activity they can do while the teachers take care of administrative matters. In Year 2 however, the Literacy Director repeatedly questioned the utility of using DOL. In one of the guided reading sessions, she explained that it was “good when it came out, but I’ve seen it in this district taking up more and more and more time,” and “we’re not sure it transfers” (Field notes, 10/18/01). A little later in the conversation she added that there is no research to show that students get it (grammar) from the worksheets. Several weeks later, in a meeting with the second grade teachers in which the Literacy Director proposed a new schedule, she made an even more pointed argument against the use of DOL:

There’s some changes that were suggested in what we saw as your schedules that you’ve been working with. And one of them was to take a look at that time from 8:30 to 9 and use that time a little differently. I think right now what I saw was mostly daily oral language, daily analogy, some daily math stuff, and I think what I’ve learned...is you don’t see transfer. They take care of kids in terms of management, but in terms of really having the kids move forward in their understanding of [language in particular] – it seems like the kids who have it have it, and the kids who don’t, don’t. You know what I mean? Like I’ll see them copy from here and those kids who can correct it, they do, and the other kids just copy what’s there and wait....I think they’re changing it [their answer] because you’re saying to change it. I don’t think they’re changing it because they actually understand. (Field notes, 12/04/01)

The Literacy Director made her opinion of DOL clear, and went on to suggest other, more productive ways the teachers could use that time, such as setting up self-selected reading for which students read books at their level. Despite her efforts however, three out of the four teachers were resistant to dropping DOL, with Heather the exception. Sondra was the most resistant, even adding a phonics element to her daily morning work in Year 3: 124

So I am doing more phonics now. Still keeping the language, still keeping the analogies and I have the phonics. And then I give them that math box that I collected; they do a math sheet every morning. So they have those three things to do before I break into my reading groups. (Interview transcript, 02/06/03)

Marcia continued to resist dropping the DOL in Year 3, not convinced that students do not benefit from it:

I personally think that they are getting something from it. Yes, there are some kids who are waiting for us to go over their work. But do they then hear the antonym or do they hear the synonym? Do they then begin to just remember to capitalize the first letter of every sentence? Because for 60-something days they have seen us capitalize the first letter of every sentence. Now from what I hear from third grade, those daily dailies [DOL] make an effect. Because third grade says to us they really can edit their daily oral language...Then to me it's making a difference. (Interview transcript, 12/05/01)

However, with more frequent talk about the importance of time on task and discussions with Ruth and Tamara about “volume of reading” and the idea that “better readers just simply read more,” Marcia began to soften her position:

Looking [at] next year...I'm gonna try getting rid of that whole big issue of that morning phonics work that we've been doing that they've been trying to get us to stop doing. And

I'm making a commitment to next year, turning that into a silent reading time 125

where...the commitment will be volume of reading, for that period of time. So, we'll see.

(Interview transcript, 02/10/03)

Unlike Sondra and Marcia who took the 'all or nothing' approach to DOL, Karen avoided that by coming down somewhere in the middle on the issue. In Year 2, she stopped doing DOL as a whole class activity, instead incorporating it into a center. As a center activity, students spent less time on it than they had before, in keeping with the Literacy Director's wishes. However, she noticed that when she stopped doing it as a whole class activity, students did not apply grammatical conventions in their writing. Hence, in Year 3, she brought the DOL back as a whole class activity:

In their writing, they weren't using any of the conventions. They weren't, but I wasn't really getting that in. And...they had a lot more difficulty. Now, when kids give me a piece...they're editing it. They know what they're looking for. I mean, they know because every morning with the daily oral language we put the capital letters and the period or a question mark; that every sentence has somethin' at the beginning and end. But on the other hand...just like [the Literacy Director] kept saying, some of the kids get it, and some don't. Some of 'em could do that every day and it still wouldn't make a difference. So I'm kind of torn between those. (Interview transcript, 02/03)

Both Marcia's and Karen's comments illustrate how experience is a persuasive teacher. Both attributed a positive effect to DOL, Marcia in the success of third graders doing DOL and Karen in her observation that when she stopped doing it her students stopped incorporating correct grammar into their writing. Even though Karen admitted being "torn," these experiences weighed heavily enough to override the Literacy Director.

teacher on the team, replaced DOL with other instructional activities. Viewing DOL as a “waste of thirty minutes,” Heather stated,

I can utilize that time...Like at least two times a week they're doing something with reading, silent reading, and journal writing at least once a week. And the other two days it's like, “Well, finish up this math page or here's a list of stuff. See what you're working on.” (Interview transcript, 01/29/03)

Thus, despite pressure from the Literacy Director to stop doing DOL, only Heather did so.

DOL was a coveted daily ritual whose keepers resisted efforts to change it. It reminds us of the difficulties associated with un-learning and that teachers are the final brokers when it comes to classroom practice.

SUMMARY AND DISCUSSION

In sum, I have described a complex knowledge creation process that began with a dialogue among various school stakeholders who recognized a need, based on a demonstrated achievement gap and a recent history of school turmoil, to support teaching and learning at Wayne. At the urging of Wayne teachers, the district Literacy Director approached university faculty member, Barbara, about forming a university/school partnership in order to support both teachers and students. By proposing to introduce several research-based principles into first grade classrooms (and later at second grade), Barbara introduced a macro-level solution, i.e., a broadly defined set of goals that created a framework for subsequent micro-level activity. In the process of proposing a research-based solution, Barbara recast the problem, originally defined as an achievement gap, in terms of specific dimensions of instruction, e.g., instructional time on task, leveled reading instruction, and so on. With a macro-level solution on the table, the

participants in the Literacy Project worked to create a micro-level solution – those specific 127
classroom structures and strategies that when implemented, would actually solve the problem.

Two mechanisms contributed to the development of a micro-solution – dialogue among project participants and practice. Through dialogue, participants combined their knowledge while developing, discussing, and reflecting on instructional practices related to literacy, discussing and solving problems related to teaching students, and scheduling and coordinating instruction. They also interpreted messages they encountered about instruction and made sense of those messages that interrupted their thinking. Through their own practice, and also by observing others in practice, participants' knowledge continued to develop and grow, particularly with respect to what works in the classroom, what doesn't work, and how. Furthermore, dialogue and practice were mutually reinforcing; teachers experimented in the classroom with ideas that resulted from discussions with colleagues and experts, and knowledge they developed in practice was the stuff of future discussions.

The Wayne case presses on our understanding of how teachers create knowledge in several key ways. First, it helps us to pinpoint the role of sensemaking in the knowledge creation process. On the one hand, sensemaking is key in that it marks the very beginning of the process. People who identify a problem in their environment and switch from automatic to conscious processing in an effort to try and understand it are sensemaking. But beyond the role of sensemaking in the beginning, the Wayne case illustrates that other mechanisms, including interpretation, combining knowledge, and practice, are also important mechanisms through which participants create knowledge.

Next, this case illustrates the opportunistic nature of solutions. What happened at Wayne is not unlike the joining of streams in public policy, the idea that solutions “float

around...searching for problems to which to become attached” (Kingdon, 1984). In this 128 case, Barbara’s solution – to introduce several research-based principles such as small group on level guided reading instruction into first grade classrooms – actually defined the problem. Whereas the problem was initially cast as an achievement gap, a rather inexact notion (simply stating there is a gap does not begin to tease apart its causes), the solution that became available – Barbara’s – spelled out the problem in specific terms. By stating they would restructure reading instruction, increase time on reading tasks for struggling readers, staff reading instruction in creative ways and so on, she signaled that the problem was specifically in the delivery of reading instruction, in the way time was allotted to carry it out, and in the way it was structured and staffed. Barbara’s solution and the school’s problem became coupled at a critical point (Kingdon, 1984), resulting in a tremendous opportunity for teachers to transform their practice. Furthermore, defining the problem was not the top-down process implied in Nonaka’s (1994) model. Instead, the teachers participated in this part of the process by brainstorming solutions, seeking out a partnership with Barbara and then giving her license to define the solution and further specify the problem.

Third, this case not only identifies the different components of the knowledge creation process, but it also examines the mechanisms underlying them. While Nonaka (1994) limits his discussion of the use of dialogue to the way in which individuals conceptualize tacit understandings (just one part of his five-part process), I find that dialogue is of paramount importance throughout the entire process, from defining the problem to developing a micro-solution. Furthermore, dialogue was not a unitary mechanism, but took on three forms, all of which contributed to the knowledge creation process in different ways. Through dialogue, teachers interpreted messages about instruction and made sense of messages they didn’t

understand. And perhaps even more importantly, dialogue enabled them to combine explicit 129 knowledge to create knowledge that was informed by research and yet situated in the local context.

In addition, rather than identifying crystallization (Nonaka, 1994) or experimentation (Engestrom, 1999) (what I call practice) as a discrete step in the knowledge creation process, I find that practice is a mechanism through which participants developed a micro-solution. In other words, practice is not a step in the process, but along with dialogue, is the way the solution gets created on an ongoing basis.

Fourth, the social nature of knowledge creation, i.e., the key role of dialoguing with colleagues and experts to develop practices, solve problems, and coordinate instruction, has implications for the traditional egg-carton classroom structure so prevalent in public education (Lortie, 1975). The Literacy Project, while aiming to support teachers and learners, began to transform literacy teaching at Wayne from an independent to a joint enterprise (Wenger, 1998). Teacher participants, moving away from whole group reading instruction toward small group on-level guided reading instruction, opened their doors to reading support staff who came into their classrooms to help teach guided reading. In addition, classroom teachers, who were now more aware of what their colleagues were doing, sent students to other classrooms for reading if they believed students' needs would be better met in a different reading group. Hence, classroom boundaries became permeable as the teachers and reading staff collaborated to best meet the needs of every second grader. Cultivating individual student progress also evolved into a joint enterprise as participants pooled their knowledge to solve problems related to teaching students from across first and second grade. In addition, teaching reading and writing became more collaborative as classroom teachers worked alongside expert teachers to develop new practices.

Furthermore, project participants made their practice more transparent to one another by 130 sharing and discussing detailed accounts of their own practice, using those accounts as the basis for further conversations in which they created knowledge.

The purpose of the community was to promote teacher interaction around practice, namely to coordinate instruction across classrooms and grade levels, to develop a shared understanding of the various literacy components, and to create knowledge about practice. Thus, the teachers' participation in this community of practice began to dismantle the egg-carton classroom structure by making teaching as well as individual student progress more transparent and also by requiring a certain degree of collaboration and coordination in order to develop and carry out a more effective literacy program. This instructional program as a site of learning is significant; curriculum is typically not designed to foster teacher learning (Ball & Cohen, 1996). However, the program at Wayne illustrates that curriculum, when constructed as a program under development rather than as a final product that is to be implemented whole-cloth, can indeed be educative.

Fifth, both outside, propositional knowledge and inside practical knowledge played a key role in the knowledge creation process. Thus, the process cannot be characterized as top-down or bottom-up, or as outside-in or inside-out. Project leaders did not provide a complete and ready-made list of new ideas for the teachers to implement. Nor did the knowledge creation process begin in the classroom and stay there. Rather, given license by the teachers, leaders proposed a macro-level framework grounded in research-based principles – including the allocation of instructional time, the utility of matching students to materials and using flexible grouping arrangements and so on – to serve as a guidepost for *practice*. This outside knowledge was merely the starting point of the knowledge creation process. The leaders did not know, nor

could they know, how these principles would come to be understood by the teachers, how 131 they would play out in practice at Wayne, or how they would interact with teachers' knowledge, beliefs, and current practices. The teachers brought to the table their current knowledge, beliefs, and practices about teaching and learning which served as a lens through which they constructed understandings of the outside knowledge. The bulk of the knowledge creation process occurred with the development of the micro-level solution, in a process of melding outside propositional knowledge with teachers' current practices and local conditions. Through the mutually reinforcing mechanisms of dialogue and practice, the participants negotiated what it means to incorporate the principles into practice, expanding their knowledge of practice so that it was informed by the research but also sensitive to and relevant in their local context. Though outside propositional knowledge served as an important starting point, it could not account nor plan for the nuances of local practice. It was through dialogue and practice that participants negotiated the local and practical meaning of the outside knowledge.

Finally, the Wayne case illustrates the ongoing nature of the knowledge creation process. Throughout my study, project participants continued to experiment with different ways of doing things. Certain new practices like guided reading did become stable over time, which is not surprising given that guided reading was deemed the most critical piece of their literacy program, thereby receiving the most attention. The teachers readily incorporated using individualized assessments to ascertain students' reading levels, grouping students accordingly, and matching students with appropriately leveled materials.

Other literacy practices continued to be works in progress well into Year 3. Writing instruction for example, though stable in that all of the teachers were committed to allocating more time to it, was in a state of flux as the teachers continued to experiment with new

approaches (within the writers' workshop framework) only to discover they were not 132
working in practice. Hence, they continued to work on and change their writing instruction. Scheduling was another work in progress as the teachers continually tweaked their schedules in search of one that would allow them to incorporate each of the literacy components optimally while allowing them to meet all of their other classroom obligations. In addition, over the course of the study they had gradually acquired guided reading books, changing the nature of guided reading instruction by allowing them to incorporate more and more materials. By Year 3 the second grade team had acquired quite a few non-fiction books covering topics in science and social studies. Rather than teaching science and social studies as separate subjects like they had in Year 1, by Year 3 they were beginning to incorporate those subjects into their guided reading instruction. Going a step further, in Year 3 they were beginning to work with Ruth and Tamara to develop themes that would integrate different subject areas simultaneously, along with various materials, strategies, and skills. Hence, after two years of intense work, the knowledge creation process continued. It is not surprising that knowledge creation is ongoing, especially in light of the ever-changing classroom and school contexts in which teachers work.

CONCLUSION

In conclusion, the case of knowledge creation at Wayne illustrates that teachers are not the passive recipients of outside knowledge who either seamlessly apply that knowledge in their own classrooms or choose to ignore it. Rather, in the context of a community of practice comprised of teachers, leaders, and subject matter experts, they combine different sources of inside and outside knowledge to create a kind of situated propositional knowledge; knowledge that is rooted in research on instruction but is also contextually meaningful. Through dialogue and practice, the participants developed a new literacy program that represented a substantial

transformation of their instructional practices. Perhaps the greatest lesson to be learned from 133
this case is that substantial change in teaching is possible when professional development is
designed in a way that fosters teachers' participation in a process of creating knowledge.
However, policymakers looking for a quick fix will be disappointed; knowledge creation is an
ongoing, arduous, and resource-intensive process.

CHAPTER FOUR

A COMPARISON OF TEACHER LEARNING ABOUT MATHEMATICS AND LITERACY
INSTRUCTION

Subject matter is a key context in which teaching is situated. Scholars have demonstrated, particularly at the high school level, that school subjects are characterized by different features that mediate the ways in which teachers teach, as well as the ways in which they interpret and enact educational policy (Stodolsky & Grossman, 1995; Grossman & Stodolsky, 1995). Although elementary school teachers, who are responsible for teaching all subjects from reading and writing to math and science, are typically thought of as subject matter generalists, research suggests that subject matter impacts the way they teach (Stodolsky, 1988). Furthermore, subject matter plays a key role in teachers' identities as teachers *and* learners (Drake, Spillane, & Hufferd-Ackles, 2001) as well as how individual elementary teachers construct opportunities to learn about teaching (Spillane, 2000). Few studies to date however, have compared teacher learning across subjects.

Teacher learning is a critical piece of the educational reform puzzle. Theoretical work on teacher learning typically takes a subject matter-neutral stance on how teachers learn, instead focusing on the cognitive, behavioral, and/or situative nature of learning (Greeno, Collins, & Resnick, 1996; Putnam & Borko, 2000; Lave & Wenger, 1991). Empirical work on teacher learning on the other hand, is typically situated in a single school subject, examining particular professional development initiatives in mathematics, reading, or science. Thus, work that compares and contrasts the role of subject matter in the teacher learning process, and specifically how teacher learning is constructed similarly and differently across school subjects, is lacking.

learning process between school subjects. The second grade team at Wayne Elementary School²⁴ engaged in a process of learning about and changing both their literacy and mathematics instruction. In this paper I compare and contrast the teachers' learning about teaching in both subjects. Their learning was situated in communities of practice that grew up around each subject matter. These communities, as a key context for teacher learning and change in both subjects, were created in response to district pressures to improve teaching and learning in both math and literacy in an effort to reduce an achievement gap between African American and Latino minority and white majority students. While these communities were created in response to the same district pressures and for the same purpose – to improve teaching and learning – they differed along one key dimension, the nature of teachers' participation in these communities and in their primary enterprise – learning. In this paper I will argue that subject matter is a key defining element of teacher learning in that it shapes, along three dimensions, teachers' participation in those communities in which such learning takes place. First, the roles teachers played in each community differed by subject matter. Second, the nature of participants' work and of the kinds of knowledge involved in that work, particularly the positioning of practice and of practical knowledge, depended on the subject. Finally, the ways in which tools were used to mediate the learning process differed by subject.

Framing the Work

I used three different domains to frame this work – subject matter as a context for both teaching and school leadership, teaching and teacher learning as situative processes, and teacher knowledge. First, subject matter is a key context that mediates the work of both leaders and

²⁴ All names have been changed.

teachers. With respect to leaders of and for instructional improvement, how leaders work to 136 improve instruction depends, in part, on their subject matter knowledge (Stein & D'Amico, 2000) and views (Burch & Spillane, 2003). In a study of instructional leadership across eight elementary schools, Burch & Spillane (2003) found that leaders, viewing mathematics as a highly defined body of knowledge, looked to external sources to develop more sequenced math programs as part of their reform efforts whereas their work to improve literacy instruction relied on a more participatory approach with teachers taking more of an active role in developing curriculum. Hence, the way leaders orchestrate reform depends on the subject. In addition, the subject specificity of leaders' reform efforts can have a lot to do with how much teachers incorporate reform ideas into their practice (Grossman, Stodolsky, & Knapp, 2004).

Not only is subject matter a critical context for the work of school leaders, but for that of teachers as well (Talbert & McLaughlin, 1993). Much of the research on the subject matter context of teaching has taken place at the secondary level (Stodolsky & Grossman, 1995; Siskin, 1994). High school teachers view school subjects differently, differentiating them along five dimensions: degree of definition, scope, sequentiality, whether they are viewed as dynamic or static, and whether classes are required or elective. Specifically, math teachers view their subject as more defined, more sequential, and less dynamic than English teachers. They also report having less control and autonomy over course content, exhibit more press for content coverage, and report higher levels of standardization and coordination than English teachers (Stodolsky & Grossman, 1995). Not only do teachers perceive subject matter differences in these features but high school math and English departments are also characterized by different norms and cultures (Siskin, 1994). Stodolsky and Grossman (1995) conclude that teachers' beliefs about subject matter with respect to these different features mediate their responses to reform proposals.

elementary school level, though less work has examined this issue. In one study of elementary math and social studies teaching, Stodolsky (1988) found subject matter differences in the kinds of instructional tasks that teachers used and in the ways teachers organized instruction. Specifically, math instruction was predominantly teacher-centered and covered uniform content while social studies instruction was less teacher-centered and characterized by less uniform content (Stodolsky, 1988). In addition, subject matter is not just an important context for teaching, but for learning about teaching as well. Subject matter plays a key role in teachers' identities as teachers and learners (Drake, Spillane, & Hufferd-Ackles, 2001) as well as how individual elementary teachers construct opportunities to learn about teaching (Spillane, 2000). Teachers' identities, specifically who they are as learners about instruction, can vary from one subject to another, differentially shaping the opportunities they construct for learning about teaching (Spillane, 2000). This study departs from prior work on the subject matter context of elementary teaching and teacher learning by comparing and contrasting teachers' participation in the subject matter communities in which they learn.

The view that learning is situated in the communities of practice in which people live and work is receiving increasing attention from scholars (Greeno, Collins, & Resnick, 1996; Putnam & Borko, 2000; Wenger, 1998). Communities of practice are made up of individuals who are mutually engaged in a joint enterprise and who develop and use a shared repertoire of tools and artifacts (Wenger, 1998). According to this view, learning is not a matter of individuals acquiring new knowledge and skills, but rather, learning *is* practice, and involves evolving forms of mutual engagement, understanding and tuning the community's enterprise, and developing the community's repertoire. Hence, what participants learn is "not a static subject matter but the

very process of being engaged in, and participating in developing, an ongoing practice” 138

(Wenger, 1998, p. 95). Furthermore, a community’s repertoire includes tools, or externalized representations of ideas and intentions used in practice (Norman, 1988), that mediate learning. Tools, as mediational means (Wertsch, 1991), are an integral part of the learning process.

Constructing knowledge is crucial to the learning process, but knowledge takes on different forms. The literature on teacher knowledge covers a large terrain. In a recent review of this literature, Munby, Russell, and Martin (2001) conclude there are two different kinds of knowledge relevant to teaching: practical knowledge and propositional knowledge. Practical knowledge is the knowledge teachers have of classroom situations and the practical dilemmas they face in carrying out purposeful action in these settings (Carter, 1990; Munby, Russell, & Martin, 2001). I equate practical knowledge with insider knowledge, or knowledge that is generated by teachers for teachers in particular classroom contexts (Cochran-Smith & Lytle, 1993). Propositional knowledge on the other hand is knowledge about teaching derived from theory and research. This kind of knowledge is similar to outsider knowledge, or knowledge that is generated by scholars for teacher consumption (Cochran-Smith & Lytle, 1993).

Some scholars distinguish between knowledge form and type. Shulman (1986; 1987) for example identifies several types of knowledge that constitute the knowledge base for teaching, including subject matter content knowledge, general pedagogical knowledge, pedagogical content knowledge, and curricular knowledge. But he also argues that these types of knowledge can take on different forms, including propositional, case, and strategic knowledge. In their extensive review of the literature, Munby et al. (2001) highlight the complexity of and tensions inherent in the different perspectives on teacher knowledge. For the purpose of my study, the distinction they make between propositional and practical knowledge as well as where that

knowledge is situated (inside or outside teacher practice) is of primary importance. 139

However, I also recognize that these forms of knowledge can be associated with different types of knowledge, particularly those which Shulman (1986; 1987) identifies. For the purpose of my comparison of teacher learning across school subjects, subject matter content knowledge, an understanding of how the basic concepts and principles of a discipline are organized as well as how the validity of propositions is determined (Shulman, 1986), is of particular importance.

Methods

This study is a longitudinal case study of the second grade team at Wayne Elementary School. In this section I will describe my site selection, data collection, and data analysis.

Site Selection

Wayne Elementary School, a K-5 school in a small city outside Chicago, was undergoing reform in both mathematics and literacy at the time of the study. For this reason, Wayne was an ideal site at which to compare teacher learning and change across both subjects. Wayne serves a diverse student population of approximately 400 students, 55% of whom are low income, and 68% of whom are from racial/ethnic minorities. I focused my study on the second grade team due to their involvement in both mathematics and literacy reforms²⁵. The members of the second

²⁵ Their involvement in literacy reforms included their participation in district-wide professional development related to reading instruction as well as their participation in an intensive collaboration with university faculty to create a balanced literacy program in the early primary grades (i.e., first and second grades) at Wayne. Their involvement in mathematics reforms included their implementation of a district-adopted reform mathematics curriculum as well as their participation in a series of professional development workshops provided by university faculty that were designed to support their use of a reform mathematics curriculum. Only the second and third grade teachers participated in this workshop series for mathematics instruction. Thus, the second grade team was the only grade level team in the school to participate in the university collaboratives in both subjects on an intensive basis. I chose to study the second grade team in order to be able to compare and contrast how the teachers learned about teaching mathematics and literacy.

grade team remained constant over the course of the study and included four teachers, as described in Table 4.1. 140

Table 4.1

Description of Second Grade Team Members²⁶

	Years Full Time Teacher	Years at Wayne	Highest Level of Education	Race/Ethnicity	Age
Heather	1	1	M.A., Elementary Ed.	African American	26
Karen	3	3	B.A., Elementary Ed.	Caucasian	43
Marcia	23	13	M.A., Elementary Ed. w/ reading concentration	Caucasian	44
Sondra	24	22	M.A., Elementary Ed.	African American	59

Before I describe my data collection and data analysis, I will briefly describe the reform efforts under way in each subject.

Reforming math teaching. In Year 1 of the study, the Wayne second and third grade teachers participated in a series of ten professional development sessions orchestrated by district leaders to support their mathematics teaching. The after-school sessions, designed and facilitated by a faculty member at a nearby university and her post-doc, addressed general topics related to teaching reform mathematics including the role of student representations in teaching and learning mathematics, student questioning, student explaining and other aspects of classroom discourse, teachers’ use of curriculum and assessment, analyzing student work to ascertain student understanding, and the use of multiple methods in problem-solving. Participants included the second and third grade teachers, the university facilitators, and on occasion, different district math leaders including the Assistant Superintendent of Curriculum and Improvement of Instruction. During the typical session, participants solved math problems using

²⁶ Descriptions pertain to Year 1 of the study.

a variety of representations (manipulatives) and discussed their different methods, read 141
research-based materials about the different facets of reform mathematics (e.g., classroom
discourse, assessment, and so on), watched and discussed video clips of teacher practice ranging
from ‘traditional’ to ‘reform’ math teaching, examined student work, and were given a follow-up
‘assignment’ to do in their own classrooms before the following session.

Reforming literacy teaching. District leaders partnered with a faculty member from a
different local university to create a professional development initiative in literacy called the
Literacy Project. Their primary goal was to provide classroom support for both teachers and
students at Wayne, beginning at first grade, in an effort to boost student achievement. In Year 1,
participants included the four first grade teachers, three reading specialists, one speech
pathologist, the district Literacy Director, the faculty member from the university, and two expert
teachers who were also affiliated with the university. Their plan was to begin the initiative at
first grade in Year 1, add the second grade teachers in Year 2, and the third grade teachers in
Year 3.

With some variation across the grade levels (with first grade classrooms receiving the
most support), the participants in the project worked to create a balanced literacy program in the
early primary grades that would provide maximum in-classroom support for both students and
teachers. The Literacy Project had several components. First, project leaders²⁷ asked the school
principal to create a block schedule that would carve out a two-hour block of time for
uninterrupted literacy instruction. Second, teachers received training on guided reading
instruction – the cornerstone of their new literacy program – learning how to implement small-
group reading instruction using appropriately leveled materials. To ensure that every student

²⁷ Project leaders are Barbara and the district Literacy Director.

received regular, small group reading instruction, project leaders brought the school's reading cadre and other support staff into the classrooms every day to teach one of that classroom's reading groups. Third, the expert teachers affiliated with the university provided regular classroom-based support by doing demonstration lessons in the teachers' classrooms. Fourth, all of the participants met monthly to discuss their practice as well as student progress. And finally, the project had a leadership component aimed at cultivating home grown leadership for literacy instruction.

Data Collection

Beginning in the fall of 2000, I collected data an average of two days per week over the course of two academic years with strategic follow-up the third year. For this paper I focused my data collection on the second grade teachers' participation in the communities of practice that grew up around each subject matter. Specifically, I observed formal meetings about math and literacy instruction. Some meeting observations were recorded as field notes in detailed narrative form while others were audio- or video-taped and transcribed. I also observed each of the four second grade teachers teach in their classrooms at multiple time points over three years. See Table 4.2 for a descriptive summary of the observational data.

Table 4.2

Observational Data

Formal Meetings	Year 1	Year 2	Total
Literacy Meetings	---	14	14
Math Meetings	8	---	8

In addition to these observations, I conducted in-depth semi-structured interviews with the second grade teachers as well as with a variety of individuals who served as informal and formal school leaders. Interviews with teachers were designed to probe them about their

participation in the math and literacy communities, focusing on any changes they had made or were in the process of making and sources of support for making those changes. Interviews with leaders were designed to question them about their leadership practice, with particular emphasis on their role in the literacy and math reforms being observed at the school. All interviews were tape recorded and transcribed. See Table 4.3 for a descriptive summary of the interview data.

Table 4.3

Interview Data

	Year 1	Year 2	Year 3	Total
Administrators				
Principal	2	2	---	4
District Literacy Director	1	1	---	2
District Asst. Supt.	1	---	---	1
Leaders of Literacy Initiative				
Literacy Project Leader	---	1	---	1
Expert Teacher 1	---	1	---	1
Expert Teacher 2	---	1	---	1
Leaders of Math Initiative				
Workshop Facilitator	1	---	---	1
Reading Resource Teachers				
Reading Teacher 1	1	---	---	1
Reading Teacher 2	---	1	---	1
2nd Grade Teachers				
Heather	2	3	1	6
Karen	2	3	1	6
Marcia	2	3	1	6
Sondra	2	2	1	5

Data Analysis

I treated my observational data as two sets – the math set which included all of the data from the math community and the literacy set which included all of the data from the literacy community. To analyze each set, I broke down each meeting transcript or set of fieldnotes into chunks of conversation, assigning each chunk a consecutive number. A change in topic or a

natural break in the conversation signaled the end of one chunk and the start of another. I 144

then coded each chunk using a coding scheme that was informed by my framework but was also data driven, and included nodes for process, knowledge, and tools. Process codes characterized the nature of the activity in that chunk and included dialogue and practice (e.g., doing math problems and doing demonstrations). I also coded each chunk for the nature of knowledge at play. These nodes included inside/practical knowledge and outside/propositional knowledge. Finally, I coded each chunk for any tools that were used, including nodes for student work, demonstrations (including formal presentations about practice, watching video clips of practice, and reading classroom transcripts), and curricular/classroom materials.

Coding was an iterative process. As nodes emerged from coding one set, I used the emergent nodes to code the other set. As patterns emerged in one subject I used them as a lens through which to examine the other. Coding and analyzing the data in this way allowed me to construct the story of each subject matter community with respect to process, knowledge, and tools, and then to compare those stories.

I analyzed teacher interviews by coding them for subject-specific topics (e.g., in math, Everyday Math program²⁸, assessments, materials, and strategies and in literacy, Scholastic Reading series²⁹, guided reading, shared reading, writing, and spelling). I then constructed a timeline for each teacher of her thinking and practice related to each of these topics. This enabled me to see how teachers' understandings and practices related to these topics changed and did not change over time. I paid particular attention to changes in practice the teachers identified as well as who or what served as resources for those changes (e.g., teammates, experts in the community, sourcebooks, and so on).

²⁸ Everyday Math is the district-adopted math program.

²⁹ Scholastic Reading series is the district-adopted reading program.

The Subject Matter Context for Teaching and Teacher Learning about Mathematics and Literacy

The school, district, and state contexts for mathematics and literacy teaching were similar in many respects. First, teachers were expected to use district-adopted curricular materials to teach both subjects. For mathematics the district adopted the Everyday Math program. This reform math series is aligned with the NCTM standards and de-emphasizes traditional computation and skill-based content, emphasizing instead mathematical problem solving and teaching for conceptual understanding. For literacy the district adopted the literature-based Scholastic Reading series.

The second similarity is the use of standardized tests to assess student performance in both subjects. A new statewide high-stakes test in reading and math made more transparent an achievement gap between white majority and African American and Latino minority students across the district. In response, district officials looked for ways to boost student achievement in both core subjects. According to the Assistant Superintendent for Curriculum and Improvement of Instruction, “The Superintendent is very concerned about the gap in performance...as we all are....So when he came in a year ago he brought in what's called the *District School Improvement Initiative* and it really focuses on literacy and numeracy” (Interview transcript, 10/31/00). In response to growing concerns about the achievement gap, district officials turned to local universities to provide professional development for teachers in both math and literacy instruction. Communities of practice formed around each subject, serving as a key context for teacher learning and change.

Despite these similarities in the state, district, and school contexts for mathematics and literacy teaching, there were also differences. District and school officials viewed literacy as the

cornerstone of learning for all school subjects. The Assistant Superintendent explained that 146
reading comprehension

affects everything a kid does in school. I mean, you can teach him all the math stuff, but at some point they have to be able to pick up a book and read directions and read through problems and sort out what they're doing....To me it's probably the most important thing we do....Poor reading affects everything. So it's the big goal. (Interview transcript, 10/31/00)

Viewed as the prerequisite for learning in all of the school subjects, literacy instruction at Wayne was better resourced in terms of both instructional time and staff. With respect to instructional time, the principal at Wayne created a new block schedule, increasing the time allotted for math from 40 to 60 minutes while creating a two-hour block for uninterrupted literacy instruction. Hence, twice as much time was devoted to literacy instruction.

In addition, fewer resources in the form of school-based staff and instructional supports were available for mathematics instruction. Specifically, the school did not employ a math specialist or resource staff, leaving math teaching largely to individual classroom teachers. Furthermore, perhaps due to a lack of formal or informal on-site leadership for math instruction, the school did not provide teachers with opportunities to learn about math teaching (e.g., in-services or opportunities to discuss math teaching during faculty or other school-based meetings). For reading, Wayne employed an extensive support staff, including three full time reading specialists, a speech teacher, and an ESOL (English as a Second Language) teacher, who provided pull-out programs to supplement classroom instruction. The reading staff also occasionally facilitated on-site professional development sessions to support reading instruction.

District and school officials expected teachers to teach the Everyday Math program from start to finish and to pace their instruction accordingly in order to complete the program before the end of the year. Because the program spirals, (i.e., topics change from one day to the next but are revisited repeatedly over the course of the school year and across grade levels in increasingly complex ways), adhering to the program was of paramount importance to ensure coordinated instruction within and across grade levels. Indeed, the principal explained the importance of teachers using the program so that “everybody’s following the same scope and sequence” (Interview transcript, 5/03/02). In addition, to help the teachers implement the program and to keep them on pace, the district sent a math cadre – a team of veteran teachers with many years of experience teaching the Everyday Math program – to periodically meet with the teachers. The relatively limited amount of time allocated to math instruction along with the rigors of teaching the Everyday Math program inhibited teachers’ use of alternative or additional ways to teach mathematics.

Likewise, district and school leaders expected teachers to use the Scholastic Series as their primary resource for teaching reading. Calling it an “anchor program,” the district Literacy Director explained that “It lets everybody know what is expected....That has to be the common thread throughout the district, so we have any sense of what anybody's doing on anything” (Interview transcript, 04/05/02). However, teachers were also granted the flexibility to use a variety of resources, in addition to the Scholastic Series, to teach literacy. Hence, the Literacy Director went on to explain that once teachers are familiar with the series, “They can just pull from it whatever they need” (Interview transcript, 04/05/02). Indeed, the second grade teachers at Wayne, though they did use the series as an “anchor” for reading instruction, chose to

incorporate it into Patricia Cunningham's Four Blocks, a model which divides instruction 148 among four components: guided reading, shared reading, writing, and working with words³⁰. In addition to implementing the Four Blocks, three of the second grade teachers also voluntarily participated in a series of professional development sessions in which they learned about fluency as a key component of reading comprehension as well as how to work fluency-based activities in to classroom instruction. Hence, the teachers took advantage of the flexibility the school and district allowed them to draw on a variety of resources to teach literacy.

Finally, though communities of practice grew up around each subject matter in response to the same district pressures (i.e., to reduce the achievement gap) and for the same purpose (i.e., to improve teaching and learning), the nature of teachers' participation in these communities differed along three dimensions – teachers' roles, the nature of their work, and their use of tools. I will address each of these differences in turn.

Teachers' Roles

The roles teachers played in each community differed by subject matter in two ways. First, in the literacy community, teachers had some control over the direction of their learning, helping to take the lead in the learning process. In the math community on the other hand, teachers had less control over the learning process, instead participating in the process as it was determined by formal leaders.

In the literacy initiative teachers had some control over the learning process by setting goals for learning and having a voice in guiding the work of the community. In fact, it was the Wayne teachers who sought a partnership with the university, eventually giving rise to the

³⁰ Using the Four Blocks model was not a school or district requirement. One of the second grade teachers had seen it in use at another school, shared it with her teammates, and together they agreed to use it to frame their literacy instruction.

Literacy Project [for a detailed account of the project's inception, please see Chapter Three]. 149

Once the partnership was established, one goal of project leaders was for teachers to actively participate in planning the direction of the project. Barbara, the university faculty member who helped spearhead the project, described engaging in a “consistent effort to try and get the teachers to engage in planning what we do and choosing what we did; trying to figure [out] where [the] direction is going and so forth” (Interview transcript, 02/20/02).

Hence, at meetings marking the beginning of the second grade teachers' participation in the project, Barbara urged the participants to set “one goal that we might share” for the year (Field notes, 10/03/01). After some discussion, the teachers decided to focus on reading comprehension and writing, paving the way for subsequent work in those areas. In sum, formal project leaders gave the teachers the authority to make decisions that would govern the course of the project, and teachers took up those opportunities.

In the math initiative on the other hand, though teachers actively participated in the work of the community, they had little control over the learning process. Planning and guiding that process was largely, though not entirely, out of their hands. One of the facilitators from the local university who led the initiative reported setting the agenda for their meetings and having it approved by the Assistant Superintendent:

I just wrote up a title page really, and said, “This is my idea of the workshop topics.”

And I gave it to [the Superintendent] and she said it looked good to her. And she didn't just glance; she really looked at it. (Interview transcript, 04/09/01)

Thus, the facilitator set the agenda for the meetings without teacher input, facilitating sessions on topics highlighted by NCTM such as classroom discourse and the use of representations in problem solving. The teachers participated fully in all of the workshops, engaging in facilitator-

led discussions, watching video excerpts from classrooms, solving math problems and 150
discussing different problem-solving methods, and examining examples of student work.

Indeed, these sessions provided a rich opportunity for teachers to talk about math teaching and learning. However, during the sixth session, a third grade teacher questioned the utility of a particular activity they were doing, complaining, “This activity is a waste of time” (Meeting transcript, 11/07/00)! Her comment paved the way for others to share their feelings about participating in a series of workshops over which they had little control. Of the teachers who spoke, many viewed the sessions in a positive light, sharing how what they were learning had changed the way they thought about math teaching and learning. However, other teachers explained that the sessions were not offering them what they wanted or needed. Marcia explained,

No one came and asked us if we wanted to do this and what were our needs before we started....Nobody said, “What do you want?” First of all, “Do you need a session? And if you do, what do you want to cover in those sessions?” And I think that’s something that, at least in this district, we as teachers are constantly being told, “You’re going to do this!” but nobody is asking us, “What do we need?”...Our impression was you guys were going to be coming in and talking [Everyday Math] and giving us some...practical activities, hands-on things to do with our kids. (Meeting transcript, 11/07/00)

Marcia’s comments suggest the teachers had little say in shaping the content and/or purpose of the math sessions, leading to a disconnect between what the designers planned to teach (the principles of reform mathematics) and what the teachers were looking to learn (hands-on activities). Viewing Marcia’s and other teachers’ comments constructively, the facilitators incorporated more ‘hand-on’ activities into the later sessions. However, in comparison to the

literacy initiative in which leaders built the teachers into the planning process from the beginning, the teachers had little control over their learning about math teaching. 151

The second difference in teachers' roles is that in the literacy community teachers were positioned as leaders whose own knowledge and practice were key resources in and for the learning process. In the math community on the other hand, teachers did not take on a similar leadership role.

One goal of the literacy initiative was to tap into local expertise and cultivate school-based leadership for literacy instruction. The district Literacy Director described a lack of collaboration at Wayne prior to the start of the Literacy Project:

I think there was very little collaboration, except maybe within a team. But across teams, there was probably none. There was little or some collaboration between [reading] specialists and classroom teachers but mostly in a polite way of "When can I take the kids?" but not really thinking together about how they're both impacting what's happening. (Interview transcript, 04/05/02)

In light of a school culture in which teaching was largely an individual enterprise, formal project leaders sought to tap into school-based expertise by creating an environment in which the reading staff could take a more prominent instructional leadership role, providing professional development for classroom teachers and taking a more collaborative approach to teaching literacy. Barbara explained that she and the Literacy Director wanted "to develop some teacher leadership within the school and ways of working together" in light of the opinion that "They have some strong people there, but the ways in working together might not have been most conducive to actually having growth" (Interview transcript, 02/20/02). The Literacy Director

further explained that the culture at Wayne inhibited potential literacy leaders from taking an active leadership role: 152

At the building...there isn't this sense of the reading specialist feeling like she should just go in to a new teacher and say, "I'd like to work with you." I'm not even sure that there's the language there for how to do it. So I think it's a limited staff development from within the building; that it could be more, much more than it is. So most of the staff development that is happening at Wayne...is outside people coming in. (Interview transcript, 03/09/01)

To better utilize home-grown expertise, the Literacy Director arranged for Coretta, one of the reading specialists, to provide regular classroom support for Karen and Heather, the two newest teachers on the second grade team. Coretta explained,

[The Literacy Director] told me that she wanted me to...help them to be able to get more time with the reading instruction. Like where they were actually engaging the children in different kinds of reading activities. And she didn't really tell me how to do it. She gave me a few suggestions, but it was kind of left up in the air. So some of the time I'm supporting whatever it is that they are doing and some of the time I'm, you know, doing demonstration lessons so that they can see other ways that they might be utilizing their time on reading activities. (Interview transcript, 03/13/02)

Both teachers reported benefiting from having the reading specialist in their classrooms. Karen described with enthusiasm one of Coretta's demonstration lessons:

She took a book that was about a median book for 2nd grade level and did it with the whole class, and showed me – which was a wonderful – the way she did step by step, it took a couple of days where they made predictions, they read the beginning of the book,

wrote a summary of it and then she would have a question for fast finishers. And she 153
did beginning, middle, end. It was three days, and [we] talked a lot about that with a
fiction story. It was a great, whole class...method. And just watching, I just sat here and
watched and helped. I personally, that's the best way for me to learn something and have
it really stick in here [pointing to her head]. (Interview transcript, 03/13/02)

Aware of expertise available inside the school, leaders of the Literacy Project tapped in to it by
arranging for a reading specialist to provide ongoing instructional support for the classroom
teachers, thereby cultivating home-grown leadership for instruction.

Contrary to the work of the literacy community, cultivating school-based instructional
leadership was not on the math community's agenda. Rather, participants in that community
worked to expand their understandings of the research-based principles underpinning reform
mathematics and to consider how those principles might change the way they approach certain
aspects of instruction like classroom discourse and the examination of student work. Indeed, the
second and third grade teachers came together to discuss math teaching and learning, but at the
end of the day, no one assumed the role of instructional leader.

Furthermore, in addition to cultivating instructional leadership among the reading staff,
expertise about literacy instruction was located both inside and outside teachers' classrooms.
Teachers in the literacy community took a lead in the learning process by developing new
practices in situ and by sharing their own expertise with other participants. Math expertise on the
other hand was located primarily outside Wayne classrooms, creating a community in which
teachers relied on formal leaders to provide leadership for instruction. This difference in teacher
roles and the location of expertise is intimately connected to the nature of the work of each
community, a point I will explore in the following section. But first, in sum, teachers'

they played. How teachers are positioned in each community in terms of their control over the learning process, their engagement as leaders in that process, and the location of expertise differed depending on the school subject.

Nature of the Work

Teachers' roles were linked to differences in the nature of their work in each community and in the kinds of knowledge involved in that work, particularly the positioning of practice and of practical knowledge. Learning in both communities was similar in that it was very much grounded in propositional, subject-specific knowledge; that is, theoretical knowledge developed through research. However, the nature of learning about teaching differed in key ways between subjects. In addition to being rooted in outside propositional knowledge, learning about literacy teaching was also partly reliant on teachers' inside knowledge in a process of bringing propositional and practical knowledge together to create new practices. Teachers made crucial contributions to the learning process in terms of their practical knowledge and expertise, making them key agents in the development of new knowledge. Hence, learning in the literacy community relied on both outside *and* inside knowledge.

While learning in the math community was also rooted in propositional knowledge, it did not rely on teachers' inside knowledge at all, instead privileging outside knowledge. In doing so, learning about math teaching was situated primarily outside of teachers' practice. Furthermore, whereas participants in the literacy community combined outside, propositional knowledge with inside, practical knowledge to develop new pedagogical knowledge (how to teach literacy), they were not concerned with developing subject matter content knowledge. In other words, assuming a solid foundation in their knowledge of the subject itself, they focused their efforts on

developing new practices rather than on (re)defining literacy as a content area. In the math 155 community on the other hand, knowledge of pedagogy *and* of mathematical content took center stage. But rather than developing new strategies to teach the same mathematics, participants in the math community worked to develop their knowledge of mathematical content, specifically redefining what it means to know and do mathematics, and how to teach given that new conceptualization of mathematics. I will unpack these subject matter differences below.

Literacy. The Literacy Project facilitators introduced participants to several research-based principles, including maximizing instructional time especially for struggling students, using assessment to organize and plan instruction, matching students with appropriately leveled materials, and providing flexible, small group guided reading instruction. This propositional knowledge of pedagogy, in part, formed the basis for the teachers' learning and change. However, teachers' inside knowledge – of their school and classroom contexts and of their current practice – played a crucial role as well. Hence, learning in the literacy community relied on facilitators' propositional knowledge of pedagogy and on teachers' practical knowledge, in a process of bringing both kinds of knowledge together to develop new pedagogical knowledge that was theoretically-driven and yet situated in the local context.

Participants brought propositional and practical knowledge together in two ways. First, through dialogue, teachers brought their knowledge about practice to conversations about literacy instruction while the facilitators brought their knowledge of current research. Through talk they were able to combine these types of knowledge in order to situate research-based principles in teachers' current practice, leading to the development of theoretically-driven and contextually relevant pedagogical knowledge. For example, in one literacy meeting, Heather brought up a problem she was experiencing with silent reading. In an attempt to situate a

principle of reading instruction in practice – that during silent reading time students should read familiar books that match their reading level – she encountered some difficulty: 156

Heather tells Joan [the facilitator], “I have not been able to figure out silent reading. How do I get the lower-level kids to read on their level?” Joan replies, “That’s what guided reading is for,” explaining that students should read the books for guided reading and then “put them in those baskets so they have books in the basket they can read.” She adds that students reading familiar books during silent reading is important for bringing down their “frustration level.” Heather asks how she can do this at the beginning of the year. Joan suggests putting alphabet books in their book baskets and listening to their reading. Then she shares how her colleague calls silent reading “read and relax time” and explains to her students that they work hard all day and “read and relax time” is their time to do just that. So “if you’re working too hard [struggling to read a book] you need to get an easier book.” (Field notes, 10/24/01)

In this example, Heather poses a practical problem she is having with respect to the silent reading ‘principle’. Although she demonstrates that she understands that students should read appropriately leveled books during silent reading, she is having difficulty getting students to do that in practice, asking Joan for help in situating the principle in her current practice. Joan responds by reiterating that students should read books they are familiar with in order to decrease their frustration and to increase their reading success. She then gives Heather practical advice, suggesting that she have students’ guided reading books available for silent reading time. This conversation illustrates how teachers and facilitators in the literacy community brought their practical and propositional knowledge together through talk in order to develop theoretically-driven knowledge that is situated in the local context.

Teachers not only brought the two kinds of knowledge together through dialogue, but 157 also by experimenting with new ideas in practice. In other words, teachers combined the facilitators' propositional knowledge with their practical knowledge in the process of teaching. For example, Tamara, one of the expert teachers, and Rachel, a first grade teacher, described how they took a principle from writers' workshop – that students are a community of writers who can learn from each other – and applied it in practice to address a particular problem they were having with writing instruction. Specifically, the teachers were having trouble teaching their first grade students how to incorporate feelings into their writing. To address this problem they created a poster titled “Examples of Feelings in Writing” that included samples of student writing that exemplified the use of feelings. Their idea was to illustrate for students what it means to incorporate feelings into their writing by showing them exemplars written by their peers.

Tamara: I used Gabrielle's [a first grader's] work in all three classes because it was so nice and it's so fun as we've been doing this. You know, we talk about the kids being a community of authors but it's really great here because the teachers are really being a good community of thinkers to get this going too. And Rachel said, “What if we used more student work samples and even had a resource that we could go to, and almost like a binder, so if we said, ‘Gosh, our kids are really lacking with adding details to writing,’ can we pull out that piece and use it?” So we had talked about that as...a grade level when it became apparent that we needed to do more with getting the kids to use feelings, you know, not just telling what they did, but how they felt during it.

[From the “Example of Feelings in Writing” poster, Barbara reads, “I was nervous when I meet people for the first time. I'm so nervous I could barf. It's just like a baby, you know, like if a baby doesn't know you they are going to cry.” Barbara adds, “Yeah, that is very good. Is she a first grader?”

Coretta: Yeah!!!

Rachel: We've really been workin' on, like I read from *James and the Giant Peach* and it's so descriptive....We would take certain sentences and [read them] over and over again, and they really got it. I was so excited [about this student's work] because it was really descriptive.

...

Tamara: But the thing we said during this mini-lesson [about incorporating feelings in writing] is, you know, “Can’t you connect with that? Haven’t you been so nervous and you felt like you were gonna barf?” And then she goes on...to give a comparison. I mean that is really complex. (Meeting transcript, 4/22/02)

Tamara describes a process of bringing propositional and practical knowledge together in the act of teaching. In this example, a problem arose in practice – “It became apparent that we needed to do more with getting the kids to use feelings.” To address this problem, participants incorporated the idea of developing a community of authors, using the exemplary work of one student to demonstrate in a “mini-lesson” what it means to write with feeling. They combined their inside knowledge of students’ weaknesses in writing with the principles of writers’ workshop to create a new strategy to teach writing. Furthermore, they shared this new strategy with other participants in the community. Hence, teachers were not just the “recipients” of knowledge but also the generators of knowledge, typically sharing knowledge developed in situ with others in the community.

Developing knowledge about literacy teaching through dialogue and practice relied, in part, on teachers’ practical knowledge. Participants combined that knowledge with experts’ propositional knowledge to develop theoretically-driven and yet contextually relevant pedagogical knowledge in the form of new instructional practices that fit with the local context. Learning was indeed a creative process with teachers assuming the role of innovator, developing ways to incorporate propositional knowledge in practice.

Mathematics. Learning about mathematics teaching was similar in that it also relied on outside, propositional knowledge. However, while learning about literacy teaching relied on teachers’ inside, practical knowledge as well, the process of learning about math teaching privileged outside knowledge and was situated primarily outside of teachers’ practice.

Furthermore, while participants in the literacy community primarily developed pedagogical 159 knowledge, in the math community they developed pedagogical knowledge *and* content knowledge.

Similar to learning about literacy teaching, learning about math teaching was rooted in propositional knowledge of mathematical content and pedagogy, particularly in the research-based principles underlying the NCTM standards. The facilitator of the meetings recounted,

The first session was just, you know, using a reform math curriculum....And then the discourse in the classroom; that's, NCTM has the principles, it's called the Standards 2000. And a lot of what I did, you know, was recommended by the NCTM. Discourse is really big. Another of the topics was on good mathematical tasks, just designing good tasks. And it's from the Standards too. (Interview transcript, 04/09/01)

Participants engaged in workshop activities that demonstrated the principles underlying reform mathematics. For example, they watched and discussed video clips and read transcripts of math lessons that demonstrated students using different representations to solve problems, students engaging in rich classroom discourse in the form of asking mathematical questions and providing mathematical explanations, and teachers facilitating that kind of rich discourse. They looked at samples of student work to ascertain students' mathematical understanding so that they could see how student work can be used as a planning tool rather than as a tool just for assessment and grading. These activities were designed to expand teachers' understandings of how to teach reform mathematics (pedagogical knowledge), and perhaps even more fundamentally, what it means to know and do reform mathematics (content knowledge).

Reform mathematics represents a fundamental shift in what it means to understand and do mathematics. Prior to the NCTM standards, mathematical competence was typically defined

as using standard algorithms correctly to solve problems. Traditional math emphasizes procedural understanding and arriving at correct answers. Reform math on the other hand emphasizes students' conceptual understanding of mathematics, encouraging students to use a variety of methods to solve problems so long as they understand and can explain the solution and how they arrived at it. With the adoption of a reform curriculum, the Wayne teachers were not just learning a new pedagogical approach to teach the same old math, but rather were fundamentally re-learning what it means to know and do mathematics. A key component of the learning process in the math community therefore was to actually *do* reform mathematics.

Doing math in the sessions accomplished several things. Consider by way of example a meeting in which the facilitator asked the teachers to solve a two-digit addition problem and then share how they solved it.

[The teachers used different methods, including the traditional algorithm as well as expanded notation. After sharing their different methods with the group, Pam said, "I want you to think about...using a representation to solve it." Pam then showed the teachers how to solve the problem $459+236$ using representations called squares, sticks and dots. Squares represent hundreds, sticks represent tens, and dots represent ones. Pam drew four squares, five sticks, and nine dots to represent 459 and two squares, three tens, and six dots to represent 236. She illustrated how to group the hundreds together, the tens together, and the ones together, crossing out ten of the dots and replacing them with a stick. Counting the resulting squares, sticks, and dots, she, with the help of the teachers, arrived at the answer.]

Pam: One reason why this is a good way to start out, especially when you're talking about place value is because of the language that comes out...Looking at this, you know, as the longs or the tens, it really kind of helps you see...that these are...your 50 plus your 30 and it's not just the...five plus three. 'Cause it's really easy for us when we're doing the traditional algorithm to say "five and three" and to forget that it's 50 plus 30. And also, when you do a picture like this, this is kind of helping you see, okay, there's that little, this right here [points to where she crossed out ten dots and added a stick and then points to the little one in the traditional solution to illustrate "carrying"], that's what that is. You know, and I think a lot of times we forget. When we say, "Put the one up there," what are we doing? You know, we've just regrouped a ten, okay? So I'm gonna ask you to solve another problem, and when you're solving it, I want you to think about how you would explain the problem, you know, kind of using the place value language of, you know, ones, tens and hundreds.

[Pam assigns the problem $245+186$ and the teachers get to work individually, solving it using squares, sticks and dots. After a few minutes, Sondra volunteers to write her solution on the board and explain what she did. When she finished, Pam asked if any of the teachers checked the answer using the traditional algorithm. Heather replied, “I think I checked because I’m like, it can’t be that easy, to just do it this way and come out. [I was just] pretty skeptical. I’m like, ‘Wait a minute!’ And then when it came out [I was quite impressed].” The other teachers also reflected on solving the problem using the representations, with Jill admitting “I had to redraw it” and Joan adding “I thought it was difficult to do this.”] (Meeting transcript, 09/12/00)

As illustrated in this meeting excerpt, doing math allowed the teachers to actually experience solving problems using methods that depart from traditional methods. By doing so, they developed their mathematical content knowledge. Over the course of the initiative, the teachers, whose own math learning preceded the penning of the NCTM standards, practiced solving problems using a variety of representations and manipulatives. Engaging in creative problem solving themselves, the teachers experienced what it is like to utilize different methods, for example when Heather shared how she thought “It can’t be that easy” to use squares, sticks, and dots, but was “impressed” when she realized that it was. This first-hand experience allowed teachers to see the utility of encouraging students to use problem-solving methods they may be more likely than traditional methods to understand. In addition, sharing their problem-solving methods allowed the teachers to articulate their own understandings and make transparent the kind of mathematical understanding that proponents of reform mathematics want students to develop.

Furthermore, the facilitator typically asked the teachers to relate solutions based on reform methods with solutions arrived at using traditional algorithms in order to make the workings of the traditional algorithms more transparent. In doing so, she brought to the surface the conceptual underpinnings of basic computational algorithms and illustrated the importance of

students understanding what it means to regroup by “carrying” when using the traditional addition algorithm or “borrowing” when using the subtraction algorithm. 162

Beyond experiencing first-hand what it feels like to use a variety of methods and articulating themselves the mathematical understanding they are striving to foster in their students, doing math and reflecting on it also allowed the participants to discuss the pedagogical aspects of developing students’ understanding, in other words, what teachers can do in the classroom to foster that understanding. In this excerpt for example, the facilitator emphasized the importance of using place value language when solving problems using representations. She pointed out that problem solving using representations provides an opportunity to teach students about place value, and that using place value language can help students to understand this sometimes difficult mathematical concept.

Doing math and talking about it provided the teachers with a rich opportunity to develop their mathematical content knowledge – particularly what it means to know and do reform mathematics – and their pedagogical knowledge – how to foster that kind of mathematical understanding in the classroom.

In sum, the nature of the learning process, and the kinds of knowledge at play in that process, was similar across subjects in that both relied at least in part on outside, propositional knowledge. However, that process also differed by subject matter. Learning about literacy teaching can be characterized as a process in which participants brought their practical and propositional knowledge together to create, through dialogue and practice, theoretically-driven and yet contextually relevant pedagogical knowledge. Learning about math teaching on the other hand was a process of developing teachers’ understandings of the principles – rooted in both content and pedagogical knowledge – underlying reform mathematics by watching and

discussing video clips of exemplary teaching practices, examining student work, and doing 163 mathematics. In the process of describing these differences in the nature of teachers' learning in these communities, I have alluded to participants' use of tools, for tools are an integral part of any practice. In the following section, I will foreground differences in how tools mediated the learning process.

Use of Tools

Along with subject matter differences in teachers' roles and in the nature of the learning process, participants used tools in different ways to mediate their participation in that process. Both communities of practice relied on a variety of tools including curricular materials, student work, and demonstrations of practice that mediated their participation in the learning process. However, participants used these tools, especially student work and demonstrations of practice, in different ways and for different purposes.

Student work. In the literacy community, teachers used (representations of) their own students' work to mediate discussions about students they had concerns about in an effort to address those students' particular learning problems. In the math community on the other hand, participants examined student work to ascertain students' mathematical thinking and understanding and to demonstrate certain reform math principles in practice [e.g., students' use of representations and their use of different (sometimes creative) methods to solve problems].

Student work – as a tool that mediated learning – took on a different form in literacy than in math. In the literacy community, abstractions of student work in the form of students' reading levels, demonstrated reading behaviors, and progress (or lack thereof) framed discussions about how to solve problems related to teaching particular students. In fact, to create a visual representation of student work and performance, the participants created a single chart on which

they recorded every first and second grade student's reading level so that they could track individual students' progress over time. As a regular part of their meetings, teachers used that information, along with their observations of student work from the classroom, as the basis for conversations in which they addressed problems related to teaching particular students. For example, at one meeting Heather brought up a serious concern she had for one of her second graders:

Heather brings up her concern about Kyle. She says he doesn't qualify for PLP [a supplemental pull-out reading program] and she doesn't see him going to third grade next year. "He's just not making progress," she says. "He can read [but he's] not using strategies [and he does] not really participate in class." Renee, Kyle's first grade teacher, adds that he was held back in first grade and that both she and Linda [another first grade teacher] had him. Mary [a reading specialist] says she had to drop Kyle from Reading Recovery because of poor attendance.... Tamara and Heather both agree that he is inconsistent. Barbara, referring to PLP, says, "Maybe they could pick him up." However Heather says that because "Reading comprehension is supposed to come in guided reading according to Susan [the district Literacy Director]," he was dropped from the PLP program. Mary suggests that "They must have had some more needy children" for PLP. Linda recommends that Heather talk to the school social worker about Kyle while Barbara suggests that Ruth take up "watching" Kyle in class to "see if she can come up with some good strategies" for him. (Field notes, 03/18/02)

This excerpt is a representative example of conversations in which participants, based on their observations of student work, engaged in dialogue to solve problems related to particular students. In this example those who knew Kyle, from his first grade teachers to the reading

specialist and his current teacher, were able to pool their knowledge of him as a learner to 165 provide a more holistic picture of him from which they could devise a solution. One of Kyle's first grade teachers suggested Heather talk to the social worker to gain even more insight into his situation while Barbara suggested that one of the expert teachers observe Kyle in the classroom to come up with instructional strategies that might help him. In other examples, participants made particular strategic suggestions such as dropping a struggling student down a reading level or matching a student with a tutor to provide one-on-one assistance. From these conversations, teachers learned strategies to teach the most difficult-to-teach students.

Interestingly, in the math community, teachers did not use (abstractions of) student work as a tool to systematically discuss individual students' progress over time or to frame discussions in which they tried to solve problems related to particular students. Instead, teachers used concrete examples of student work, particularly students' solutions to math problems, to do two things: to ascertain students' mathematical thinking and understanding and to demonstrate certain reform math principles in practice.

First, participants examined student work, both examples the facilitator provided and examples from their own classrooms, in order to ascertain students' mathematical understanding. During these exercises, the facilitator urged the teachers to focus not on what students don't know mathematically, but rather what they do know, pressing them to delve into students' mathematical thinking and understanding. In one meeting for example, the teachers shared samples of their students' solutions to the following problem: *Kate counted five fish, three turtles, and some frogs in the pond. She counted fourteen animals altogether. How many frogs are in the pond?* Diane, a special education teacher, shared how one of her students solved the problem:

Diane: I have two special ed. Students; they're fourth graders, but we did the second grade problem. And one of them drew fourteen animals and he just told me [his explanation] because he's a non-reader. He drew fourteen animals and then he went back and circled the five fish, the three turtles, and just counted the ones that were left. 166

...

Pam: So what does that tell you about that child mathematically? What do you take from that, about this problem, that that child can do?

Diane: Well, that he was understanding the number, that he understood the concept because he drew fourteen animals when I said 'altogether.' He knew...what that word meant, because right away he drew fourteen. They all look the same [referring to his representations of the animals]. But...when I asked him "How many were frogs?" I kind of explained to him that we needed to find out how many frogs were in the pond and we went back to these numbers here [pointing to the student's paper]. But I think that really, that's what I got from it. That he just needed that, "[I] have to come up with fourteen animals altogether."

Pam: So what did you think that he couldn't write an equation?

Diane: Hmmm.

Pam: I mean, were you happy with that, without an equation?

Diane: For him? Yeah...because he had some concept of what he needed to find out.

Pam: Right. Right. No, because that's what my interpretation is, is that even though he doesn't have an equation, conceptually, and with a picture, he shows that he understands the problem. (Meeting transcript, 10/24/00)

In this excerpt Pam presses Diane to think about what her student knows about mathematics from looking at his solution to the problem. In this and similar instances of teachers examining their own students' work, the teachers practiced using student work as a tool to pinpoint what their students know and do not know about mathematics. However, they did not discuss how they might use that information to scaffold individual students' learning. In other words, they did not link the practice of examining student work, as a potentially powerful planning tool, with instruction. In the literacy community on the other hand, conversations about individual students that were framed by student work focused on instruction, yielding specific measures teachers could take to help those individuals learn.

Second, the facilitator used samples of student work to demonstrate how principles of reform mathematics play out in real-life classrooms, including how students engage in rich mathematical discourse and use a variety of representations to solve problems. For example, in one meeting whose focus was classroom discourse, the facilitator showed the teachers video clips of individual students solving problems at the chalkboard and explaining their solutions to the class. This demonstration illustrated students actively taking part in mathematical discourse, serving as a kind of exemplar of the kinds of rich discourse that are possible in reform classrooms. In another meeting that focused on students' use of representations to solve problems, she asked the teachers to examine the representations different students used to solve a story problem about frogs and flies, highlighting the typical developmental trajectory of students' representations from the detailed pictures typical of first graders to the symbolic representations of older students. By looking at these examples of student work, teachers were able to see the principles of reform math in practice.

Demonstrations of practice. Although demonstrations of practice mediated learning in both communities, they took on different forms and performed different functions. In the literacy community participants relied on demonstrations of practice in and from their own classrooms to develop new practices and to share new practices with colleagues. In the math community on the other hand they relied on demonstrations from classrooms outside the school (in the form of video clips and classroom transcripts) to illustrate the principles of reform mathematics in practice.

In literacy, participants relied on demonstration lessons, situated in their own classrooms, as a key learning tool. Demonstration lessons, taught by expert teachers on a regular basis, were an integral part of the learning process in that they allowed the teachers to develop new

instructional practices alongside expert teachers. These demonstrations allowed teachers to 168 learn how to implement change in their particular classroom contexts. For example, Karen enthusiastically described a new strategy she learned from observing Ruth implement a readers' workshop in her classroom:

Now Ruth has been coming in....This reader's workshop is what she's been doing. This has been a wonderful, wonderful thing where they each have a bag with books; their just-right books....I think it'll help a lot. I was trying last year, I mean, I had different baskets of books where I would have all different levels in a basket and then the group would have those books to choose from. And that worked better than before where I didn't really have any system and they just, I'd just say, "Okay, it's silent reading time. Find a book!" That was an improvement. But this is a big improvement....I love this system....And it's different. The whole silent reading time is much more different....Even kids that are hardly ever on task have been sitting there reading....Just Monday I noticed that Shane...because he...always wants to have a book like *Where's Waldo* or something where it's all pictures. And he's a good reader when he sits down and reads. And the format seems to work for someone like that. (Interview transcript, 03/13/02)

Ruth's demonstrations allowed Karen to see firsthand how to structure students' independent reading time to ensure that they would read books at the appropriate level. By observing this new practice of using "just-right" book bags, Karen could see how to do it in the context of her classroom as well as observe how her own students responded to the practice. Indeed, observing firsthand that students who were hardly ever on task under the old system were actually reading under the new system gave her an incentive to change her practice. Karen, echoing the

sentiments of her colleagues, concluded, “I definitely think that the best way for a teacher to learn is to see another teacher doing it” (Interview transcript, 03/13/02). 169

Not only did teachers rely on the experts’ demonstration lessons to learn how to implement new strategies in their own classrooms, but they also used demonstrations to share those practices developed in situ with other participants in the literacy community. In meetings, participants presented lessons they taught and watched video clips of instruction from one another’s classrooms. In one meeting for example, the participants watched a video of Marcia facilitating writers’ workshop. While they watched the video, Tamara highlighted certain aspects of the lesson that she wanted to demonstrate to the group, particularly how Marcia clearly set up the purpose of the lesson and how she incorporated student work.

Tamara turns on the video. In it, Marcia teaches her students a ‘mini-lesson’ on incorporating details into writing, saying to them, “I took two of your stories from yesterday...and I know we shared stories yesterday...” While the video is playing Tamara says, “Notice what she says.” On the video Marcia continues, “What I did is I took two stories. They are both good stories. I think one of them shows a little more detail than the other and I want to share that with you today. Alright, so let me start...”

Tamara stops the video and says, “So notice, she sets the purpose and she also uses the student work to shape her lesson, okay?” She turns the video back on which shows Marcia reading the student samples and explaining to her class that she wants to talk about the differences between the two stories.

Tamara stops the tape again and says, “Now, so nice and clear for the kids. They have these great examples and now when they go to write, hopefully they’ll be thinking about details in their own writing.” (Meeting transcript, 04/22/02)

This excerpt illustrates how participants in the literacy community used excerpts from their own practice as a tool to demonstrate practices they were developing in their classrooms. 170

Specifically, Tamara used the video to illustrate what it looks like in practice to clearly set up the purpose of a lesson in writers' workshop and to use student work as part of that lesson. On other occasions, teachers used video clips and presentations to demonstrate additional strategies for teaching both writing and reading comprehension (e.g., teacher modeling), the use of instructional tools, (e.g., using a tool called the "four quadrants" – a graphic depiction of a story's setting, characters, problem, and solution – as the basis for student writing), and students' use of academic vocabulary (e.g., students using the language of authors such as "publishing" their "chapter books"). These demonstrations by teachers for teachers were representations of concrete practices being developed in the classroom. They allowed participants to share and examine those strategies that seemed to be working in the context of their own classrooms.

In the math community on the other hand, demonstrations were not "home grown," nor were they used as a way for teachers to work alongside experts to develop new practices or to share their own newly developed practices with other participants. Instead, locating expertise outside the community rather than inside, the facilitators used demonstrations from outside Wayne to illustrate, generally speaking, the principles of reform mathematics. These demonstrations did not illustrate how to implement particular practices in Wayne classrooms, but rather the exemplary kinds of teaching and learning teachers should be striving for. In other words, they demonstrated the desired destination without providing a map for how to get there. Struggling with the meaning of these exemplars for their own practice, the teachers tried to situate what they observed in these outside demonstrations inside their practice.

from an unidentified classroom that demonstrated second graders asking mathematical questions in class. After reading the transcript, Marcia

brings up a concern she has regarding time, explaining that she typically spends 45 minutes to an hour on math each day. “This would take 45 minutes – having them talk about one journal page. Am I correct in assuming you could spend 45 minutes on modeling this?” Pam tries to reassure her by saying, “You don’t necessarily do it every day” and explaining that this type of skill – students asking questions – is not limited to math and really cuts across subjects. Marcia however, seems to want a concrete directive. “Should I allot once a week for this type of activity or do it more often?” she asks. “How much time do I spend on this as opposed to the math journal sheet? You can only do so much. What do you give up?” Other teachers nod in agreement. Marcia continues, “Like today. We spent an hour on ‘Broken Calculator³¹.’ There is so much to do for the curriculum that we have to start making choices. In the long run will it help with the standardized tests or should we do computation? There are so many different messages! The bottom line is the Superintendent [cares about] how they do on the Stanford Achievement Test. Do we work toward that or on the child as a whole?” Pam replies that the reform curriculum will help their students “in the long run.” (Field notes, 09/26/00)

This exchange illustrates the teachers’ attempts to situate what they observed in demonstrations from outside Wayne – in this case, students engaging in mathematical discourse – in the reality of teaching in a Wayne classroom; a reality characterized by a limited amount of time allotted for

³¹ Broken Calculator is a computation game from the Everyday Math program.

math instruction and a press to move through the curriculum in a timely fashion. Marcia 172

wanted to know exactly how to incorporate the kind of rich classroom discourse she saw in the demonstration into the context of her own practice. Seeing demonstrations from outside their practice that illustrated the principles of reform mathematics, the teachers often tried to situate what they saw in the reality of their current math teaching.

In sum, tools, especially student work and demonstrations of practice, mediated teachers' participation in the learning process in different ways and for different purposes. In the literacy community participants used student work to mediate discussions in which they tried to solve problems related to teaching particular students by pooling their knowledge about those students and devising an instructional plan. In the math community on the other hand they used student work as part of an exercise to ascertain student understanding but they did not use that information to plan future instruction. Furthermore, in the math community they used student work along with demonstrations from outside their practice to illustrate the principles of reform mathematics whereas in the literacy community they used demonstrations to develop new practices *in situ and* to share those practices with other members of the community.

Differences in Learning Outcomes

The differences in the nature of teachers' participation in each subject matter community led to different outcomes. Learning about literacy teaching was a process that privileged teachers' practical knowledge and expertise, was situated in practice, allowed teachers some control over the process, and led teachers to change their practice and to buy in to those changes. Learning about math teaching on the other hand privileged outside knowledge of content and pedagogy, allowed teachers less control over their learning, and although they did learn and

change their practice in some ways, led them to challenge what they were learning in other 173 ways. I will describe these different outcomes in turn.

Literacy. Teachers in the literacy community learned and changed their practice in significant ways. To illustrate, consider the case of Marcia. In Year 1, Marcia taught reading to her whole class using the Scholastic Reading series and did limited small group instruction using only the series materials. By Year 3, Marcia was assessing students on an ongoing basis to determine their reading levels, placing those students into flexible small groups for reading instruction, and facilitating guided reading in those groups using appropriately leveled materials. Marcia, who attributed these changes to her participation in the Literacy Project, was doing small-group guided reading instruction five days a week in addition to whole-class Scholastic activities two days a week. Describing these changes to her reading instruction, Marcia said,

The kids are getting a lot more time on task on instructional level material. In the past I had groups that I worked with on guided reading but we didn't use a lot of the small instructional level books. They weren't available to us...So you had, you might've had 3 reading groups last year but they were all basically using the source book from Scholastic. And the high group was doing fine, the middle group was doing okay, but the low group was not getting what it needed in terms of appropriate reading material.

(Interview transcript, 01/28/02)

Marcia's experience is representative of how all of the second grade teachers changed their practice. All of the teachers shifted from doing whole group reading instruction using only the Scholastic materials to including small-group, on-level guided reading instruction in their regular schedule, in keeping with the research-based principles that guided their learning. Thus, by participating in the Literacy Project, the teachers developed a new literacy program, changing

practices, how they delivered reading instruction, and how they used materials. They also changed their approach to writing instruction, from squeezing it in when they had the time to implementing an organized writers' workshop for longer periods several days a week.

Furthermore, the teachers embraced the changes they were making, viewing them as making a lot of sense. For example, all of the second grade teachers referred to small group on-level guided reading instruction – the cornerstone of the changes they were making – as a sensible approach to teaching reading. Karen explained,

With the guided reading and the leveled books, having kids reading different things at their level; where before we were all reading from Scholastic. And that was, that's probably the best change. That makes the most sense. And having, you know, we're gonna have a lot more materials too to do that. It's a lot more labor intensive but it makes so much more sense. The kids, you can see them progressing because they're more engaged because they're at, doing what's right for them at that time. That's working.

(Interview transcript, 5/22/02)

The idea of differentiated instruction – of teaching students at their instructional level – made sense to the teachers. In addition, the teachers did not view some of the things they were learning as much of a departure from what they were already doing. Indeed, Marcia explained that guided reading

is not new. Teachers have always been helping children learn how to read by modeling, by having them practice, by reading with each other, by reading at home, by being read to. It's not new. I think what's new is making the children more accountable for their learning. (Interview transcript, 10/17/01)

Similarly, Sondra viewed the idea of modeling the writing process for students, something 175 that Tamara was demonstrating in her classroom, as not departing too much from the way she taught writing in the past. However, she did learn some new strategies:

Well it's basically the same. I will do more of the strategies that she used. That's giving me something to do. But basically it's the same where I model and then they write. Now she brought in a lot of graphic organizers. I'm going to use maybe one or two graphic organizers next year when I do writing and I'm going to show them how to do that to organize their thoughts before they go and start to write their paragraph. That would be about the only change...Most of it I was doing but maybe not in the same order that she was doing. (Interview transcript, 05/16/02)

In sum, learning about literacy teaching was a process in which teachers were key participants and innovators, combining their practical knowledge with experts' propositional knowledge to create a new literacy program that, because it was situated in their current practice, fit with their own classroom contexts. They learned and changed their practice in fundamental ways in certain respects (e.g., shifting from whole group to small group reading instruction) and in incremental ways in other respects (e.g., using more graphic organizers to teach writing), viewing these changes as sensible. Although it was not easy, and at times they struggled to make changes that they perceived to be challenging, the teachers, for the most part, bought in to the learning process.

Mathematics. In the math community, the teachers also learned and changed their practice. For example, three of the second grade teachers incorporated the principle of students taking a more active role in classroom discourse by giving their students more opportunities to

“teach” the class and explain how they solved problems or by urging them to ask

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mathematical questions. Referring to what she took away from the workshops, Karen reflected,

Probably the biggest thing from that is the, is having the kids explain, going up and explaining, and I just go to the back of the room; instead of being up there telling everything, to [sit] back and let them explain their thinking. (Interview transcript, 02/03)

Another idea teachers took from the workshops is that it is okay for students to use different methods to solve problems. Two of the teachers reported this as an important change in their thinking about math teaching. Heather, when she was made to realize that it is okay for students to use different methods (including different representations) to solve the same problem, reported

feeling...relieved knowing that the kids can use different methods. You know, because I'm thinking, “Oh my goodness! So and so still needs to use manipulatives!” You know, “What's wrong with me as a teacher?” As opposed to thinking, “You know, that's where that kid is at that stage.” And so I feel really comfortable now, you know, realizing that it's okay if some kids are at different stages and if they need a little bit more help. (Interview transcript, 01/25/01)

Relatedly, three of the teachers encouraged their students to use representations to solve addition and subtraction problems – namely those referred to in the workshops as ‘sticks and dots’ –

rather than relying solely on traditional algorithms. Marcia explained,

The lesson that I did at the beginning, just the warm up with the sticks and the dots, that is new to me. That is something that we worked on last year with the [university] facilitator. And I didn't believe it would be beneficial but I have seen the more I use it with kids, it really does help that low-end kid understand a concept of why that one ten

got moved from the ones to the tens column. And so that was something that I learned 177 new, that's something I put into my bag of tricks. (Interview transcript, 12/05/01)

Hence, the teachers did learn and change their practice in ways that reflected the work of the math community, namely by encouraging their students to engage in mathematical discourse by questioning and explaining their work and by urging them to use problem-solving methods with which they were comfortable. Moreover, these changes did not conflict with the teachers' current beliefs and practices.

However, they did perceive a disconnect between other principles of reform mathematics and their own knowledge and beliefs about teaching, leading them to challenge those principles. They did not easily buy in to ideas that seemed disconnected from [and that they struggled to situate in] their current practice. For example, the teachers often spoke of their reform math program as failing to meet the needs of lower students because in their view, it did not give adequate attention to computation, it required students to demonstrate their mathematical understanding in writing (potentially confounding math ability with writing ability), and its spiraling nature meant teachers were supposed to move on to new topics before students had a chance to master prior ones. Using a reform math program and seeing its effects firsthand, the teachers did not buy in to what they saw as a program that was disconnected from the realities they faced. They had difficulty integrating the principles of reform math with the reality of their current practice and what they believed their students need. Marcia explained,

I'm doing [Everyday Math] with the kids. I'm introducing all the concepts, but I still have that little book that is working on regrouping, and I still have that little book that is giving them practice with their addition and subtraction. Do I think they'll get better at it because they're using some of the [Everyday Math] games? Yes, I do. But I haven't

given up that traditional pen and pencil practice that I think, deep down, I truly believe they need. (Interview transcript, 11/15/00) 178

Marcia, along with her colleagues, did not buy in to the idea that practice with computation is second to students' engagement with mathematical concepts. Hence, she supplemented the reform math program with traditional skill work.

Viewing math as a sequential subject with prior learning as a prerequisite for subsequent learning, the teachers also did not buy in to the spiraling nature of the math program. Sondra explained,

With this math program we have, they feel like you teach it to them once and boom, go on to the next thing. They need that constant review in order for them to internalize what you're trying to teach them. That's just my philosophy. And we all feel like that.

(Interview transcript, 01/31/01)

The teachers often complained that the program moved too quickly, finding it difficult to move on to new topics before students had a chance to master prior ones. Rather than following the program as written by teaching one lesson each day, they took their time teaching topics they felt students needed more time to master.

Throughout their participation in the math community, the teachers were never sure that reform math was "right" for their students or made the most sense in light of their local context. Although they were challenged to relearn what it means to know and do mathematics, they found it difficult to embrace a definition of mathematics that seemed to conflict with their knowledge and beliefs about what their students need. Instead, as Marcia stated earlier, they were looking more for "hands-on activities" that they could add to their "bag of tricks."

Discussion and Conclusion

The teachers at Wayne had a problem – an achievement gap between minority and majority students in both mathematics and literacy. Though the problem was the same in each subject and the desired end was the same (to eliminate that gap), the means to that end – teacher learning and change – were constructed differently in each subject matter.

In math, district officials responded to the achievement gap by adopting a reform math program to which they expected every district teacher to adhere. The switch from a more traditional math program to a reform one signaled that the problem could be solved through the adoption and implementation of a curriculum that challenged teachers to redefine math teaching and learning according to the principles of reform mathematics. The response the district constructed to address the achievement gap in mathematics was curricular control; the answer lay in teachers following the ‘script’ provided by the prescribed program as well as in understanding the logic of that script. Furthermore, the reliance on a curricular program that was developed outside teachers’ practice privileged outside knowledge. Hence, teachers needed to learn two things: what it means to know and do mathematics according to the principles of reform mathematics and how to foster that kind of mathematical understanding using the prescribed program. A community of practice was created in which teachers could construct an understanding of reform mathematics and how to teach it.

In literacy, the district constructed a different response to the problem. The response to the achievement gap was not one of controlling teacher practice through the adoption of a curricular program, but to give teachers the opportunity to use propositional knowledge about literacy teaching to define and develop a solution to the problem in the context of their own

classrooms. Learning about literacy teaching therefore was not a matter of constructing an understanding of knowledge developed elsewhere (how to use a particular curriculum for example), but involved the creation of knowledge as the result of combining outside and inside knowledge. Furthermore, the solution did not require teachers to redefine what it means to be literate. Their definition of literacy did not change. Instead, the solution lay in developing better, more effective ways to deliver instruction. Hence, teachers participated in a community of practice in which the response to the achievement gap was to involve teachers in the creation of new, situated knowledge. 180

In a case study I cannot conclude that subject matter caused these different responses to the achievement gap problem. However, the different responses to calls for reform differed by subject in ways that we might expect given what we know about subject matter, specifically that math teachers (at least at the high school level) report having less control and autonomy over what they teach and feel more press for content coverage than English teachers (Stodolsky & Grossman, 1995). In keeping with this trend, the policy response for math was to control what teachers taught through the adoption of curriculum while the response in literacy was to give teachers more control over teaching and their own learning process. Indeed, my findings suggest that subject matter permeates educational processes at all levels, including how reform, and the learning (and un-learning) that is a part of that reform, is constructed.

The policy responses in both subjects required teachers to learn, but because each response was associated with a different objective, the learning process was constructed differently in terms of the roles teachers played, the nature of learning involved and the kinds of knowledge at play, and how tools mediated the process.

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First, teachers played different roles in the communities in which their learning about practice was situated. Teachers in the literacy community had more control over the learning process and played a key role in the development of new practices and the sharing of knowledge in the community. In the math community teachers had less control over the learning process and did not engage in a process of developing new practices or sharing knowledge developed in situ with others in the community. Instead, participants in the math community were expected to learn and adopt a reform view of mathematical understanding and of teaching mathematics, rooted in knowledge that was developed outside of teachers' practice. This difference is due, in part, to where participants located expertise in each community. In keeping with prior work (Burch & Spillane, 2003), the locus of expertise for literacy teaching was both outside and inside the school; the learning process privileged teachers' knowledge of practice as well as experts' knowledge of research on literacy teaching. Locating expertise about literacy teaching, in part, in teachers, placed teachers and teacher practice on center stage of the learning process (giving them more control). Furthermore, viewed as experts in their own right, teachers shared their expertise with others in the community. The locus of expertise for learning about math teaching on the other hand was located primarily outside the school; learning privileged the prevailing reform definition of mathematics and math teaching. Locating expertise about math teaching primarily in outside sources gave teachers a more peripheral role in defining the learning process (giving them less control).

Not only is the locus of expertise associated with the roles teachers played in the learning process, but it is also associated with what kinds of knowledge are involved and how they come to play in that process. In literacy, teachers assumed a central role in a process that privileged their practical knowledge in addition to outside propositional knowledge. Teachers were viewed

as having an important contribution to make in a process of bringing together their 182
knowledge and outside knowledge to develop new practices in situ. In math, teachers assumed a
more peripheral role in a learning process that privileged outside knowledge over teachers'
inside, practical knowledge. Rather than seen as the creators of new knowledge, teachers were
viewed as the recipients of outside knowledge.

These differences in teachers' roles, the locus of expertise, and the relative importance of
teachers' own knowledge, suggests a not-so-subtle insistence on the part of math education
experts that teachers have little to add to the teacher learning process in terms of their own
knowledge and practice. The district leaders and university experts responsible for orchestrating
instructional reform in mathematics at Wayne had a clear picture of what they wanted the
teachers to learn (a new, reform conceptualization of mathematics and how to teach it) and how
to go about it (adopting a reform math curriculum, showing teachers its virtues, and ensuring that
teachers use it). Their position led to a learning process in which they "gave" teachers the
conceptualization of mathematics and math teaching they wanted teachers to have without
paying much attention to what they already understood about mathematical content and math
instruction. But this is ironic considering that the kind of teacher learning policymakers are
aiming for – learning for which teachers restructure their knowledge frames to make room for
new knowledge – needs to start with teachers' current knowledge, beliefs, and practices
(Spillane, Reiser, Reimer, 2002). Teachers' histories of mathematical understanding and
practice serve as a lens through which they perceive messages about teaching and learning.
Further, they serve as the starting point for constructing new understanding. The failure to
consider teachers' inside knowledge and practice may be partly responsible for the wide gulf

teachers perceived between reform mathematics and their current understandings and ways of teaching. 183

Moreover, with respect to the debate about teacher knowledge, my findings complicate the distinction between outside and inside knowledge (Cochran-Smith & Lytle, 1993). Participants in the literacy community brought these two kinds of knowledge together to develop a kind of knowledge that can't be easily relegated to either category – knowledge in the form of locally constructed practices that were grounded in propositional knowledge and yet situated in teachers' classrooms. Hence, my findings reinforce the need to think carefully about how we conceptualize and categorize teacher knowledge.

Second, prior work tells us little about the relationship between subject matter and the tools that mediate the teacher learning process. I find that tools – especially student work and demonstrations of practice – were used differently in each subject matter community. In the literacy community, participants used student work to focus discussions in which teachers, in the process of constructing a new literacy program, together tried to solve problems related to teaching particular students. Participants in the math community, constructing an understanding of the principles underlying reform mathematics, used student work to ascertain students' mathematical understanding (a key part of reform math) without discussing the implications this might have for local practice. In addition, it is interesting to note that even though demonstrations were a key learning tool in both subjects, they were constructed differently. For literacy, learning was situated in local demonstrations to illustrate newly developed practices. In math on the other hand, learning was situated in demonstrations from outside their practice to demonstrate the general principles of reform mathematics. These findings suggest that subject matter does shape how tools mediate the learning process.

Finally, the work of each community led to different outcomes. What teachers were learning in the literacy community was situated in local practice, made sense to them, and led them to buy in to the changes they were collectively making. What teachers were learning in the math community was situated primarily outside the classroom and seemed disconnected from what their knowledge and experience from inside the classroom was telling them, leading them to challenge the new knowledge. 184

Specifically, in the math community, the teachers took away certain ideas that resonated with their thinking and practice that they could readily integrate into their current instruction, for example, encouraging students to use representations in their problem solving and asking them to explain their solutions to problems. Yet while they taught math using the Everyday Math program by district mandate, they did not necessarily agree that using a reform math curriculum was the solution to their problem, nor did they reconstruct their views and understandings of mathematics in ways that were completely aligned with a reform conceptualization of mathematics. Instead, in implementing the Everyday Math program, they observed that the students whose achievement in math they were trying to boost continued to struggle. Ironically, seeing those students continue to fall short of achievement goals led teachers to resist the very initiative that was meant to solve the problem. In the teachers' view, reform math was not accomplishing what it was touted to accomplish – to boost achievement of the neediest students while eliminating the achievement gap.

The teachers' response to the curricular policy – to implement the surface features of the Everyday Math program without truly understanding the logic of reform mathematics – is not surprising considering what Mrs. Oublier (Cohen, 1990) taught us over fifteen years ago. Mrs. Oublier wholeheartedly believed that she had staged an instructional revolution in her classroom

by adopting certain features associated with teaching for mathematical understanding – for 185 example, using concrete materials and cooperative grouping techniques. However, lacking a deep conceptual understanding of mathematics herself, she used these new features, not to press her students to make connections between mathematical concepts or to engage in rich mathematical discourse by explaining their thinking and questioning one another, but to maintain a traditional teacher-centered and skill-centric classroom. The Wayne teachers are similar to Mrs. Oublier in that they too implemented certain features of reform mathematics, embracing those they perceived as fitting into the logic of what they were already doing. However, unlike Mrs. Oublier who believed in the changes she made (even though she misunderstood them), the Wayne teachers questioned and resisted many of the changes being asked of them, making the effect of the reform all the more tenuous.

As I mentioned earlier, those leading the math reform did not allow teachers to take a prominent role in the learning process, instead predetermining what they wanted teachers to learn and change. In addition, the leaders did not approach the mathematics reform, and the learning and change it required of the Wayne teachers, with much understanding of the teachers' current thinking and practice. Hence, they did not approach the teacher learning process in a way that would take into account where teachers were starting from nor were they able to anticipate how teachers would respond. The literacy case shows us that given a voice in the process and the opportunity to contribute their own knowledge, teachers can learn and change their practice in ways policymakers hope for while understanding and embracing those changes. Rather than viewing teachers as merely part of the problem, leaders of the literacy initiative viewed them as an integral part of creating a solution. In mathematics, if leaders had given the teachers a more powerful voice in the learning process, perhaps they could have constructed a solution together,

one that takes into account teachers' beliefs and practices. At the very least, involving teachers more centrally in shaping reform would force leaders to use teachers' current beliefs, understandings, and practices as a starting point for learning and change, increasing the probability that teachers would buy in to change and embrace it. 186

In conclusion, we already knew that subject matter is a defining element of teaching and leadership practice. This study suggests that subject matter permeates not only teaching and leadership, but how stakeholders construct instructional reform and the opportunities to learn about teaching practice that are such an integral part of reform.

CHAPTER FIVE

CONCLUSION

Teacher learning is fundamentally important to recent efforts to reform instruction in schools across the United States. As part of their efforts to raise student achievement, school officials often look to teachers to change their classroom practices, relying on them to use new curricula or different pedagogical approaches. Making these changes requires teachers to learn how to teach in new and different ways and to un-learn sometimes deeply-held patterns of past practice. For instructional reforms to find success, we need to fully understand the processes through which teachers learn and change as well as the obstacles that stand in the way of learning and change.

One theory that holds promise for helping us to better understand the teacher learning process is organizational sensemaking (Weick, 1995). This theory emphasizes the interpretive, social, and ongoing nature of constructing understanding, moving us away from a conceptualization of learning as something that occurs at formally designated times and in predetermined ways (in professional development workshops, for example). On the contrary, teachers have the potential to engage in sensemaking any time they encounter a message about teaching they have difficulty understanding (a policy directive for example) or experience an event they find puzzling (e.g., a classroom lesson that students failed to grasp). Furthermore, the sense teachers make – the understandings they construct of puzzling messages and events – is partly dependent on their identity, including their knowledge, beliefs, and current practices. Thus, applying a sensemaking lens to the study of teacher learning forces us to broaden our notion of what teachers learn as well as where and how that learning takes place.

Only a few studies to date have explicitly examined the teacher sensemaking process 188 (Coburn, 2001). So while it is clear that sensemaking theory has the potential to enlighten the study of teacher learning, the teacher sensemaking process remains somewhat of a black box. Hence, one of the primary purposes of this dissertation was to examine the process of teacher sensemaking and its relationship to teacher learning in order to better understand sensemaking as a mechanism through which teachers learn. I addressed this issue primarily in Chapter Two – the case of teacher learning about mathematics. Exploring the teachers’ participation in efforts to reform their mathematics instruction, I deconstructed the teacher sensemaking process and found that teacher sensemaking is rooted in different types of knowledge, takes on different forms, and leads to different outcomes. Specifically, I found that sensemaking rooted in practical knowledge can be prospective as well as retrospective, a finding that departs from prior thinking (Weick, 1995). In addition, teachers who make sense of cues rooted in practical knowledge are typically able to construct plausible understandings of those cues, thereby incrementally changing their practice. However, sensemaking rooted in propositional knowledge – knowledge developed outside of teachers’ classrooms – is not always successful. In other words, teachers who attempt to make sense of, for example, a policy directive they find puzzling, may not, even after repeated sensemaking attempts, construct a plausible understanding of it, especially if they perceive a sizeable disconnect between the policy and their current practice. Thus, teachers who fail to construct a plausible understanding of a policy cue are less likely to change their practice in ways the policy intends. I argue that these failures may be due, in part, to the absence of effective brokers to span the boundary between the communities whose participants write instructional policies and the classrooms where teachers implement them. Brokers who have a firm understanding of instructional policies as well as firsthand knowledge

of teachers' current classroom contexts could have helped the teachers understand the logic 189
of the new math policies and translate those policies into practice.

In deconstructing teacher sensemaking, I also found that reifications, such as classroom stories, policy directives, and curricular materials, are instrumental in that they constitute the cues that sensemakers extract from their ongoing flows of experience (Weick, 1995), allowing multiple participants in the sensemaking process to focus their attention on the object in need of attention. Without reifications, sensemaking would not have taken place.

Finally, the math case begins to shed light on the relationship between teacher sensemaking and learning. I found that sensemaking is only one mechanism through which teachers learn and change. Indeed, the teachers also learned by interpreting messages about instruction they encountered as they carried out their work and by actually doing mathematics themselves, a more experiential type of learning. Hence, learning and sensemaking are not synonymous. Not only does sensemaking sometimes result in a *failure* to learn and change, but if we equate sensemaking and learning we miss two other important mechanisms through which learning takes place.

The finding that sensemaking is only one mechanism through which teachers learn is confirmed in the literacy case. In Chapter Three, like in the math case, I set out to deconstruct the teacher sensemaking process, but in the context of literacy reform. However, it soon became clear that applying a sensemaking framework to the literacy case was limiting in that it allowed me to capture only one part of a much broader and more captivating story: a story about knowledge creation. Indeed, the literacy case is not merely a case of teachers learning by interpreting messages about instruction or making sense of messages they found puzzling, but is more accurately characterized as a case of teachers learning through the creation of new

knowledge. I found that the teachers participated in an ongoing knowledge creation process 190 comprised of three components: recognizing and defining a problem, creating a macro-level solution, and creating a micro-level solution. Participants in that process, including school and district leaders, outside consultants, teachers, and parents, recognized the problem as an achievement gap between white majority and African American and Latino minority students. However, it wasn't until a solution became available – a partnership with a university faculty member who proposed to introduce several research-based principles into early primary classrooms – that the problem was specified in technical terms. The solution, in a way, preceded the definition of the problem. Furthermore, the solution that participants took up not only defined the problem but also set the stage for the development of a micro-level solution, the real 'meat' of the knowledge creation process.

One contribution of the literacy case is that it not only demonstrates the components of the knowledge creation process, but allowed me to unpack the mechanisms underlying it. I found that dialogue, not surprisingly, was one of two primary mechanisms through which the teachers created knowledge. But while dialogue is typically seen as a unitary phenomenon, I identified three different forms of dialogue – sensemaking, interpretation, and combining knowledge – that contributed to the creation of knowledge. While sensemaking and interpretation are not limited to the knowledge creation process, (indeed, as we saw in the math case the teachers learned by interpreting messages and by engaging in sensemaking without creating knowledge), combining knowledge through dialogue is part of what sets knowledge creation apart from other kinds of learning. Participants used dialogue to combine teachers' explicit inside knowledge with experts' explicit outside knowledge to create knowledge that was informed by research and yet situated in the local context. The importance, evident in the literacy

case, of combining explicit knowledge departs from prior work in that rather than relying on 191 the enlargement of individuals' tacit knowledge and the articulation of participants' shared tacit understandings (Nonaka, 1994), knowledge creation at Wayne was very much rooted in participants' explicit knowledge and its combination.

The second mechanism underlying the knowledge creation process was practice. I found that practice, unlike Nonaka's (1994) "crystallization" or Engeström's (1999) "experimentation" was not a discrete step in the knowledge creation process, but rather was a mechanism, like dialogue, through which knowledge was created.

While Chapters Two and Three deconstructed the teacher sensemaking and knowledge creation processes, the purpose of Chapter Four was to explore subject matter as a context for those processes and to identify the similarities and differences across mathematics and literacy. While we know that subject matter is a key context of teaching, (Talbert & McLaughlin, 1993; Grossman & Stodolsky, 1995; Stodolsky, 1988) very little work has compared the teacher learning process across subjects. I found that even though school stakeholders were responding to the same problem in both subjects – an achievement gap – and created communities of practice for each subject in which teachers would learn about teaching and learning, the nature of teachers' participation in those communities differed along several interrelated dimensions. First, teachers' roles differed in that they had more control over their learning and played a crucial role in the creation and sharing of new knowledge in the literacy community. Moreover, knowledge creation in the literacy community relied on teachers' inside, practical knowledge as well as experts' outside, propositional knowledge. In the math community on the other hand, teachers had little control over their learning; math experts from outside the school determined what the teachers would learn and how. Moreover, expertise was located primarily outside the

school. Hence, learning in the math community privileged outside, propositional knowledge 192 about reform mathematics, without taking into account teachers' current knowledge, beliefs, and practices. Second, the nature of the learning process differed across subjects. While participants in the literacy community combined their explicit knowledge to create new knowledge, participants in the math community interpreted and made sense of existing knowledge. Third, participants in each community used tools differently, including student work and demonstrations, suggesting that subject matter shapes the way tools mediate learning processes. Finally, I found that these differences in teachers' roles, the nature of learning, and tool use are associated with different outcomes. Participants in the literacy community embraced and bought in to the learning process and to the changes they were making in practice whereas participants in the math community challenged the learning process and the changes being asked of them.

Implications

The results of my dissertation have several implications for how we think about teacher learning and the design of learning opportunities associated with instructional reform. First, these findings suggest that teachers are more likely to buy in to learning and change over which they have some control. Thus, to increase the likelihood that teachers will change their practice in desired ways, school officials need to include teachers in conversations in which they set instructional policy and make decisions regarding what teachers will need to learn and how. While I am not suggesting that teachers have the final word when it comes to making decisions regarding instructional reform, (there are plenty of teachers who believe they do not need to change their practice at all), when decisions pertaining to classroom instruction and reform are made entirely from the top-down as we saw in the math case, teachers may be more inclined to rebuff them, thereby maintaining the instructional status quo. The trick is to find a middle

ground between top-down and bottom-up decision-making; a delicate balance that considers 193 both leaders' and teachers' perspectives on how teachers need to change, what they need to learn, and how.

Second, these findings highlight the importance of designing teacher learning opportunities that use teachers' knowledge, beliefs, and practices as a starting point. In the math case, the outside professional developers did not know what the teachers were bringing to the table and in some ways tried to fit a square peg into a round hole. The teachers perceived a vast disconnect between what they were learning and the realities they faced in their classrooms. If the developers had gone in to the process with an understanding of the teachers' current practices and goals, their dispositions toward reform and an understanding of the local policy climate, then they would have been able to scaffold the teachers' learning more effectively. We need to design teacher learning opportunities that are specific to the teachers participating and that address their unique circumstances. Teachers who perceive that the distance between instructional reforms and their current knowledge and practices is too large for them to cross are destined to assimilate reforms to fit with what they are doing already and to not learn or change very much.

In addition to designing teacher learning opportunities that scaffold teachers' learning according to their current knowledge, beliefs, and practices, we also may be able to improve teacher learning outcomes through the careful deployment of brokers. Although more research is needed to examine how brokers might enable (and constrain) the teacher learning process, individuals who have a firm grasp of instructional policies and who also understand the particular challenges faced by teachers may be able to help those teachers translate policies into practice.

Finally, this dissertation illustrates that subject matter does help to define not only the 194 teacher learning process but how school officials respond to calls for reform in the first place. Policymakers need to be aware of these differences and to reflect on and question their motivation to construct different policy responses based on subject matter.

Future Research

The findings presented in this dissertation shed light on how teacher learning is similar and different across subjects, but we know little about why these differences exist. Future work is needed to explore the reasons underlying the differences I have observed, which are likely tied to the subject matter beliefs of school officials who make decisions about instructional reform. In the Wayne case, an important question left unanswered is why, when responding to the same problem, did district and school leaders construct a response for literacy that was so different from the response for math? What accounts for the different responses and for the differences evident in the respective teacher learning processes? Furthermore, are certain responses and learning processes more effective in some subjects than others? Future work might also extend the study of teacher learning to other school subjects such as science and social studies to see how learning about teaching those subjects compares to the findings presented here.

The math case in particular suggests that brokers may be needed to span the boundary between the communities in which instructional policies are written and the communities of teachers expected to implement them. We need to explore the role that brokers might play in helping teachers to translate policy into practice. In addition, more work is needed to unpack the role of tools in teacher learning in order to better understand the relationship between different types of tools, different learning processes and mechanisms, and learning outcomes.

Finally, in this dissertation I was not able to explore the emotional component of teacher learning. Throughout the study however, teachers' emotions surfaced in ways that seemed to shape their work and their responses to reform. In order to more fully understand teacher learning and change, future work needs to examine the role of emotion, and particularly how emotion mediates teachers' responses to instructional policies. 195

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