

**Elementary School Leadership: The Development and Distribution of
Knowledge for and about Instruction¹**

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Knowledge is critical to the instructional innovation process. In order to teach, teachers need to have knowledge of the subject matter content, general pedagogy, pedagogical content, curriculum, learners, educational contexts, and educational ends, purposes, and values (Shulman 1986). Further, to successfully implement the more intellectually rigorous instructional practices advanced in reforms over the past decade, teachers will have to unlearn and relearn a great deal about subject matter content and pedagogy (McLaughlin & Talbert, 1993; Cohen & Barnes, 199?). Changing core dimensions of teaching such as the knowledge represented in classroom tasks and classroom discourse patterns, is arduous and complex and dependent on teachers developing new knowledge about instruction. Hence, it is important to understand how knowledge is developed and distributed in schools, especially knowledge about the core technology of schooling; that is, teaching and learning.

In this paper, we examine the distribution of knowledge for and about instruction in elementary schools identifying salient school actors to whom teachers turn for different types of knowledge (e.g., pedagogical knowledge, knowledge of students) and across different school subjects. Using both quantitative (social network analysis) and qualitative data (ethnographic field notes and in-depth interviews), we explore two aspects of knowledge distribution in urban elementary schools. After framing our work and describing our research approach, we consider how the distribution of knowledge about instruction is a function of knowledge type. Specifically, we argue that both the density and nature of the knowledge networks in the elementary school depend on both the subject matter and on the type of knowledge about instruction. Next, we analyze the process of knowledge transfer and construction paying particular attention to the role of artifacts/ boundary objects and boundary spanners in this process. We conclude with a discussion of some issues our analysis raises for research.

Framing the Work

The successful implementation of innovation in organizations depends on communication (Schein, 1983). Indeed, the major challenge for organizational leadership may not be decision-making or goal development but implementation. This may be especially true for schools where teachers practice as isolates in the egg crate school structure and where administration is only loosely coupled to the core technology of schooling (Weick, 1976; Lortie, 1977). In our scheme, however, school leadership and school administration are not necessarily synonymous. We take a distributed perspective on school leadership (Spillane, Halverson, & Diamond, 1999; 2000). Our distributed leadership framework argues that leadership activity is *distributed* in the interactive web of actors, artifacts, and situation, which form the appropriate unit of analysis for studying leadership practice. From this perspective leadership practice is not the purview of positional leaders, rather it is stretched over the work of both formal and informal leaders. Further, the material, cultural and social situations are constitutive elements of leadership practice, fundamentally shaping its form.

A formal position of authority in the organizational hierarchy then is not necessary for leadership. Leadership is contingent on expertise (Barnard, 1938). School principals may effectively coordinate and control instructional activities only when they have been acknowledged as credible sources of advice on instructional matters (Friedkin & Slater, 1995). Our own work suggests that other teachers are an important source of leadership for teachers and when teachers identify other teachers as leaders, they frequently invoke the human capital of these individuals; that is, the knowledge, expertise, and skill of the individual (Spillane, Hallet, & Diamond, 2000; Spillane, Diamond, & Jita, 2000). Authority and influence are dependent on

the validation of those who are subjected to it. As Barnard states, “the decision as to whether an order has authority or not lies with the persons to whom it is addressed and does not reside in persons of authority . . . “ (1938, p. 163). Adopting a distributed perspective on leadership, we see instructional knowledge as something that is not necessarily the purview of those in formal leadership positions.

The concept of knowledge is complex having different aspects of facets and scholars offer a variety of typologies for thinking about knowledge. For example, while some knowledge is declarative (i.e., knowing what), some is procedural (i.e., knowing how). Hence, any investigation of the development and distribution of knowledge in schools has to be cognizant of knowledge type. Schools present their own challenge when it comes to analyzing knowledge in organizations. Some recent efforts to understand schools as learning organizations have begun to focus on types of knowledge (e.g., Louis & Kruse, 1997; Louis and Leithwood, 1997). Considering our interest in relations between leadership and the core technology of schooling, we focus on two dimensions of instructional knowledge – subject matter and aspect of instruction.

Subject matter is an important context for teachers’ work (Ball & Lacy, 1984; Little 1993; McLaughlin & Talbert, 1993; Siskin, 1990; 1991; 1994). Although most elementary teachers do not have well defined subject matter specializations, and do not work in situations where organizational arrangements (e.g., departmental structures) directly support subject matter identities, subject matter appears to be an important context for their practice (Stodolsky, 1988; 1989). For example, Stodolsky found that topic coverage and intellectual goals were more uniform across classrooms in mathematics compared with social studies. Subject matter is also an important context in elementary school teachers’ efforts to reform their teaching because

teachers' identities as teachers and as learners about teaching can differ from one subject to the next, influencing their efforts to reconstruct their practice in these subjects (Drake, Spillane, & Hufferd, 2000; Spillane, 2000). Hence, attention to subject matter is important when considering knowledge for and about instruction to pay.

Knowledge for and about instruction is complex and multi-dimensional. Hence, some sort of typology is essential when thinking about instructional knowledge. Shulman's work on teacher knowledge is especially relevant here. Content knowledge refers to the facts of a discipline – the knowledge, understanding, skill, & disposition that are to be learned by students (Shulman, 1987, 9). It refers to the logic and structure of the subject domain including both substantive structure (i.e., ways in which the concepts and principles of the discipline are organized) and syntactic structure (i.e., the ways in which truth or falsehood are established in the discipline (Schwab, 1978; Kennedy, 1991). General pedagogical knowledge includes principles and strategies of classroom management and organization that appear to transcend subject matter (Shulman, 1987, p. 8). Pedagogical content concerns pedagogy in a particular discipline and focuses on how particular topics and issues are organized, represented, and adapted to the diverse interests and abilities of learners (Shulman, 1987, p. 8). It includes, among other things, knowledge of the preconceptions, understandings, and misunderstandings of the subject matter that students bring and what representations they are likely to understand (Shulman, 1986; Kennedy, 1991).

Curricular knowledge involves the programs designed for the teaching of particular subjects and topics at a given level, the instructional materials available, and the characteristics that serve as both the indications and contraindications for the use of particular curriculum or program materials in particular circumstances. Knowledge of learners and their characteristics

concerns students' cultural backgrounds and interests and is important in order to make representations interesting to students (Shulman, 1987; Kennedy, 1991). Knowledge of educational contexts ranges from knowledge of the workings of the group or classroom to knowledge of school governance and finance (Shulman, 1987, p. 8). Within this broad category, we include knowledge that relates to organizational maintenance and functioning (i.e. organizational routines, policies, and procedures) as well as knowledge of instructional resources. Finally, the wisdom of practice is the maxims that guide the practices of able teachers (Shulman, 1987, p. 11) – it is knowledge that comes from the teacher's experiences in the classroom.

Our distributed frame also presses us to consider how the development and distribution of knowledge is stretched over people as well as material and cultural artifacts in the school (Rogoff 1990; Lave 1988). Knowledge, understandings, and meanings, gradually emerge through interaction and become distributed among those interacting rather than individually constructed or possessed (Pea, 1993). If knowledge is distributed among participants in a specific activity context, it is necessarily situated as well (Greeno, 1997) – intimately welded to the context and the activity in which and by means of which it is constructed (Salamon, 199?). Hence, the activity of knowledge development and distribution is central.

Conceptualizing schools as communities of practice, knowledge is viewed as part of a shared repertoire at the disposal of community members and who engage in joint enterprise (Wenger, 1998). “The repertoire of a community of practice includes routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions, or concepts that the community has produced or adopted in the course of its existence, and which have become part of its practice” (Wenger, 2000, p. 83). Hence, knowledge is not fixed, static, objective, but

rather open to joint interpretation and negotiation. These communities are emergent and may or may not follow formal institutional boundaries and/or definitions (Brown & Duguid, 1991).

Methodology

This paper is based on data from the Distributed Leadership Project, a four-year longitudinal study of elementary school leadership funded by the National Science Foundation and the Spencer Foundation. The six-month pilot phase was conducted during the Winter and Spring of 1999 and involved 7 Chicago elementary schools, four interview only sites and 3 schools where we conducted interviews and extensive fieldwork. The first full year of data collection got underway in September 1999 and involved eight Chicago elementary schools, two of which were also part of the study's pilot phase. This phase of data collection was completed in June 2000 involving between 50 and 70 days of fieldwork in each of our eight sites.

Site Selection. Schools were selected through the logic of theoretical sampling (Glaser, 1978; Glaser & Strauss, 1967). Schools were chosen based on five dimensions. First, all schools in our study are high poverty with a minimum of 60% of students receiving free or reduced lunch (See Table 1). Second, we selected schools that varied in terms of student demographics including 7 schools that are predominantly African American, 3 that are predominantly Hispanic, and 3 that are mixed (See Table 1). Third, while we were chiefly interested in schools that had shown signs of improving mathematics, science, or literacy instruction (in terms of either process or outcome measures), we also wanted some schools that had managed no change in instruction. Further, we wanted to vary schools in terms of the duration of their change efforts. We used the Consortium on Chicago School Research longitudinal database to identify elementary schools that have shown indications of improvement on measures that include “academic press,”

“professional community,” and “instructional leadership” (process measures) and “academic productivity.”² Our 13 schools fall into three broad categories in terms of instructional change—change efforts in the past 1 or 2 years, tangible indicators of change over past 3 – 5 years, tangible indicators of change over the past 5 – 10 years.

For the purpose of this paper we focus on five of our eight schools. Four agreed to complete our network survey (See Appendix A). Data from these schools are the basis for the first part of the main section of the paper below. The second part of this section focuses on the activity of knowledge transfer and construction in schools relies on interview and observation data from one of these schools, Dodge, and another school in our study, Hillside.

Network Data. Data for the network measures comes from survey responses to *The Distributed Leadership Study Teacher Network Survey*, designed to gather teacher-to-teacher and teacher-to-leader interactions as well as advice seeking information across subject matter and dimension of instruction. The ten-page, thirty-seven question survey was presented to four Chicago public schools in the Spring of 2000, a fifth school completed the survey in Fall 2001 and these data are currently being processed.

Data Collection and Preparation. The response rates for the four schools included in this analysis range from 52% to 86% (See the table below). The lowest response rate is for Baxter, a school where only 34 of 66 identified teachers returned surveys. The three other schools---

² The *academic press* measure gauged the extent to which students felt that their teachers pushed them to reach high levels of academic performance. For *professional community* we used measures of collegiality (the degree of collective work ethic among staff), teacher-teacher and teacher-principal trust, and shared norms among staff. The *instructional leadership* measure assesses teachers' perceptions of principal and teacher leadership (e.g., questions about setting standards, communicating a clear school vision). Finally, the *academic productivity* measure uses ITBS scores to determine the academic gain for students spending the entire year at individual schools. This measure is used to determine the productivity of schools over time. While we will use the Consortium's data on “academic productivity”, a weakness with this measure is that the ITBS is inadequate to assess students' mastery of the more challenging reading and mathematics content. Further, all of these measures are proxies for a schools' engagement in instructional improvement and improvement should not be attributed to school leadership. In addition

Dodge, Kelly, and Bittman--- had response rates above 63%, 75% and 86% respectively. For example, 45 of the 73 teachers (63%) at Dodge returned a survey. Similarly, 12 of the 16 (75%) teachers at Kelly returned a survey. By far, the highest response rate was for Bittman where 36 of the 42 classroom teachers returned a survey (86%).

Survey Data Entry and Analysis. Entry personnel were trained on the logic of network analysis and the construction of *The Distributed Leadership Study Teacher Network Survey*. Following this initial training, each individual entered the data into preformatted Microsoft Excel spreadsheets that contained both school specific listing of teacher names listed as both row and column headings (affiliation matrices) or school specific listing of teacher names by row with resources listed as column headings (incidence matrices). Once the entire survey was processed, all personnel met together to discuss various data entry issues that arose and a written protocol was developed to handle the problem not only for the effected school but also for future survey entry work. Once the protocol was completed, data was entered again by another data entry staffer to ensure the accuracy of the first data entry pass as well as correct any problem areas in accordance with the new protocol. This procedure was used for each school such that data for each school was not entered twice (double punched) but done in a standardized fashion.

After the data was entered and double punched, each newly created matrix was separated from the MS-Excel workbook of spreadsheets and submitted to UCINET, Version 5.0. Once converted to a UCINET data set, each data set was further processed to create measures of degree centrality, network centralization, and network density using UCINET v.5.

Measures. We decided to focus on degree centrality, network centralization, and network density in order to quickly identify who the more prominent actors in the various networks were

to these measures, we interviewed school personnel and observers of the system to obtain their nominations of potential sites.

(individual or micro-level analysis). Further, this strategy also allowed us to identify how those individual characteristics were related to the overall characteristics of the networks themselves (school or macro-level analysis). Degree centrality is a measure of the number of connections that one actor has with another actor (affiliation). Degree of centrality can be used to compute two distinct measures -- in-degree centrality and out-degree centrality. In-degree sums only the number of times that “A” has been chosen while out-degree counts the number of times that “A” has chosen someone else. Centrality allows one to talk about the way in which a particular individual is related to all other individuals in a network. Closely related to degree centrality is the index of centralization, a measure of the extent to which a network is centered on a small number of actors or not. Measured in percent, higher percentages indicate that the variation among centrality measures of all the actors in the network is low compared to one or more individuals while lower percentages indicate the opposite.

In contrast to centrality and centralization, which are measures that highlight prominence within a particular network, density is the ratio of actual ties in a network to the total number possible. Consequently, density is a measure of the level of “activity” within a given network. Theoretically, this particular measure can provide insight into the extent to which there is activity surrounding the particular idea or concept in question. In or case, density gives us a sense of how connected actors are within particular subject matter areas and across the various dimensions of instruction.

Qualitative Data. To analyze the process of knowledge transfer, we used field note and interview data from Hillside and field note data from Dodge. Our primary source of data for each school was field notes of formal meetings. From Hillside we used field notes from five faculty meetings, nine 2nd grade level meetings, and eight 5th grade level meetings collected over

a 12-month period. From Dodge we used field notes from ten faculty meetings, five 2nd grade level meetings, and five Leader Team meetings collected over a nine-month period. Once the data were collected we coded them using paper coding methods. First we reduced our data to the relevant units of analysis - excerpts of field notes in which knowledge moved from one person or group to another. We then coded each unit of analysis according to the following scheme:

- a) The type of meeting in which the transfer occurred;
- b) The source and destination of the knowledge, particularly whether they were administrators or teachers;
- c) The type of knowledge involved according to the typology of teacher knowledge outlined above; and
- d) The mechanisms used, such as artifacts, routines, or actors.

We used these codes to unpack the mechanisms underlying knowledge transfer as a process and to understand how these mechanisms differ depending on the type of knowledge involved and the actors who are providing and receiving it. We approached the coding as an iterative process, further refining our codes and analyses over time.

Knowledge Distribution and Subject Matter

Examining knowledge networks in four of the elementary schools in our study we uncovered substantial differences in knowledge distribution between subject matters. Specifically, our analysis uncovered three related patterns in these four elementary schools' knowledge networks as reported by teachers in our network survey. First, the degree to which knowledge networks are centralized depends on the substance or focus of the network. Second, school administrators (i.e., principal and assistant principal) are central in elementary school's general knowledge network but not in subject matter specific knowledge networks. The

principals and assistant principals dropped out almost completely from having prominent roles in the subject matter specific knowledge networks in three of the four schools. Third, the configuration of central actors in these knowledge networks shifts depending on the subject matter. We unpack each of these patterns below.

The degree to which subject matter specific knowledge networks were centralized varied among literacy, mathematics, and science. Network centralization varied by subject matter (see Table 2). In general, teachers' literacy knowledge networks were more centralized than their mathematics or science networks (with the exception of one school). For example, for Kelly School the in-degree centralization measure went from 13.23 for reading to 3.04 for science. This suggests that the knowledge for literacy in this school comes from a small group of actors to whom a large number of the teachers turn for advice about reading instruction. Patterns of centralization by subject matter, however, differed among schools. While the knowledge network for reading was considerably more centralized than the knowledge network for science at Kelly school, the knowledge network for science was much more centralized than the knowledge network for reading at Bittman school. At Bittman, the most central figures to whom teachers turned for knowledge about science instruction were the science lab teacher (in-degree centrality 12.3) and a fourth grade teachers (in-degree centrality 16.9). Hence, school level factors appear to mediate the influence of subject matter on knowledge networks in schools.

Table 2. In-degree Centralization by Subject Matter by School

	Kelly	Baxter	Dodge	Bittman
Reading	13.23	9.8	5.98	8.31
Math	10.19	3.31	3.99	12.67
Science	3.04	4.45	5.99	16.06

A second pattern concerns the centrality of formal leaders in knowledge distribution networks. By virtue of their boundary-spanning activities and access to resources, positional leaders can develop a central position in networks more readily than super-ordinates (Friedkin & Slater, 1995). Hence, we expected that the principal and assistant principals and other formal leaders would occupy more central roles in school knowledge networks. While formal leaders were central in general discussion networks, they did not occupy central positions in subject matter knowledge networks. The role of administrators (i.e., principals and assistant principals) in knowledge networks shifts in fundamental ways when one compares general knowledge network with subject matter knowledge networks. In three of the four schools, teachers' reports indicate that school principals and assistant principals drop out almost completely from having a central role in the knowledge distribution network. Our analyses suggest that the centrality of formal leaders in elementary schools' knowledge distribution networks depend on the substance of these networks. This challenges other findings regarding the centrality of principals and other school leaders in the advice seeking networks of teachers. Prior work suggests that principals play the most prominent roles in school advice seeking networks because the egalitarian structure of schools works against the development of informal leadership. (Friedkin and Slater 1994). We suggest that the emergence of informal leadership may be tied to specific facets of teachers work (i.e. subject matter) while formal leadership may be subject matter neutral and more generic.

A third pattern concerns relations between the positions of those who occupy central positions in these knowledge distribution networks and the subject matter. Specifically, the configuration of actors who occupy influential positions in these networks varied depending on the subject matter. Take Kelly School for example. For literacy two actors were most prominent

– the principal (16.1 normalized in-degree centrality; nominated by 5 teachers) and the eighth grade teacher (12.9 normalized in-degree centrality; nominated by 4 teachers). For mathematics, neither of these actors was nominated as a central figure. Instead, the third grade teacher was seen as most central (10.7 normalized in-degree centrality; nominated by 3 teachers) while the assistant principal and fourth grade teacher each exerted some influence (each with a normalized in-degree centrality of 7.14; nominated by 2 teachers). Finally in science no individual emerged as central. Several people were nominated by one other actor. The situation was similar at Bittman school. In language arts the most central leaders were the writing lab teacher and a first grade teacher. In Mathematics, the most central actors in terms of in-degree centrality were a fifth grade teacher (14.6; nominated by 9 teachers) and a sixth grade teacher (12.5; nominated by 8 teachers). Finally in science two different leaders were most prominent a fourth grade teacher (16.9; nominated by 12 teachers) and the science lab teacher (12.3; nominated by 9 teachers). Therefore, subject matter plays a large role in determining the configuration of the most prominent actors by subject matter area. While we expect the degree centralization to increase when we narrow the boundaries to school professionals, it should be noted that the networks in general were not highly centralized. This suggests that subject matter leadership in these schools is distributed across multiple actors.

Our analysis of these knowledge networks is ongoing. For example, differentiating among different types of knowledge within each subject area, we are currently examining whether and how the patterns of knowledge distribution vary depending on the type of knowledge— content coverage, teaching strategies, materials. Another issue concerns how the distribution of knowledge in the organization varies depending on where the school is in the change process. For example, Dodge school has a relative new leadership team which has met

with considerable resistance which may help account for the lack of centralization in knowledge networks at that school.

The Practice of Knowledge Development and Distribution: The Cases of Dodge and Hillside

Much workplace knowledge is collective - embedded in social activity: It is not only held collectively but also applied collectively within a pattern of social relationships (Spender, 1994). While the preceding analysis identifies the patterns of social relationships, it sheds limited light on the activity of knowledge distribution. Work on knowledge development and distribution in organizations (Orr, 1996; Wenger, 1999) suggests that knowledge tends to be both social and dynamic. Hence, it is important to analyze knowledge development and distribution as a practice that is stretched over the interactive web of actors, artifacts, and situation. We can consider people together with the artifacts that play a role in the knowledge development and distribution activity as a single 'complex cognitive system' (Hutchins, 1991, p. 54-55). Focusing on two of our study sites we take a preliminary examination of the activity of knowledge development and distribution in elementary schools.

A key concern for us in this paper is the practice of knowledge development and distribution. While the preceding analyses enable us to identify knowledge flow within the organization, it provides rather limited insights into the practice of knowledge construction and transfer. Conceptualizing elementary schools as a system of communities of practice, below we explore the use of artifacts in knowledge distribution both between and within communities of practices as well as the role of boundary spanners.

One can conceive of the many subgroups of actors within elementary schools, whose members are mutually engaged in a joint enterprise and who share a repertoire in the pursuit of that enterprise, as different communities of practice. These communities of practice, as a part of

the broader organizational context, constitute a salient context for teacher practice (Talbert & McLaughlin, 1993).

For our purposes, several distinct communities of practice within the two schools are particularly salient. First, there is the administration, including the principal and assistant principal, who mutually engage in the joint enterprise of running the school (e.g. planning, budget-making, leading instruction, organizing, hiring and firing, and disciplining) using a shared repertoire of knowledge and tools (e.g. policies, resources). Second, the grade level teams at these schools³ also constitute communities of practice since the members of these teams mutually engage in teaching students at a particular grade level and draw on a shared repertoire of knowledge and tools that is particularly relevant for teaching students at that grade. Third, the Personnel Professional Advisory Committee (PPAC) at Hillside is a community of practice of teachers who mutually engage in the practice of writing and monitoring the School Improvement Plan. Finally, the Leader Team at Dodge is a community of practice of teachers and administrators who engage in the practice of airing concerns and making school-based decisions. Many other communities of practice, both those that are formally delineated and those that are not, exist in these schools, but for this analysis we focus on the communities of practice identified above.

One primary distinction we will make in the following analysis is how the knowledge transfer process that occurs *between* communities of practice differs from that process which occurs *within* communities. We make this distinction because for the administrators and teachers in our sample, the smaller communities of practice (e.g. grade level teams, administrative teams, leader teams) within the school community at large provide a salient context for their work. Additionally, these communities cannot be considered in isolation from one another; their

various enterprises are closely interconnected (Wenger, 1998) with a common mission to collectively meet the needs of every student the school serves. To facilitate the distribution of knowledge for instructional innovation, we must understand how knowledge moves within a community and more importantly, how knowledge that originates in one community of practice permeates the boundaries of other communities that might benefit from it.

Specifically, we will analyze the use of artifacts, routines, and actors in knowledge transfer and how the use of those artifacts, routines, and actors differs in the knowledge transfer between communities compared with that within communities. Further, drawing on the typology of teacher knowledge outlined above, we will also highlight how the types of knowledge that actors share between communities of practice differ from the types of knowledge that actors share within communities.

Knowledge Distribution Between Communities of Practice: The Role of Artifacts and Routines

One pattern that emerges from our work at Hillside and Dodge is that tools play a key role in the transfer of knowledge in schools, particularly between different communities of practice. Two types of tools, artifacts and routines, are particularly salient in the transfer of knowledge between the administration as one community of practice, on the one hand, and the teachers and grade level teams as other communities, on the other hand.

By artifacts we mean externalized representations of knowledge, ideas, and intentions used by practitioners in their practice (Norman, 1988). Artifacts are mediational means that enable actors to engage in purposeful activity (Wertsch, 1996). We have found that actors use artifacts to engage in the purposeful activity of transferring knowledge, particularly when that transfer occurs between communities of practice. A particular type of artifact that actors use to transfer knowledge between communities is the boundary object. Boundary objects including

³ For our analysis we focused on the 2nd and 5th grade level teams at each school.

artifacts, documents, terms, concepts, and other forms of reification are one type of connection among communities of practice. Through boundary objects, practices of different communities influence each other (Wenger, 1998). Carlile (1999) borrows Star's (1989) definition of boundary objects and defines them as objects that are shared across different problem-solving contexts. In his study of the use of boundary objects in new product development, he identifies two types of boundary objects that are relevant to our work. One is repositories, or objects that supply a common reference point or resource for solving problems. Another is forms and standardized methods which "provide a shared format for solving problems across different functional settings" using a mutually understood structure and language that "makes communication of problems more conventional and less problematic across different settings (p.26)." Finally, Obstfeld (1999) conceives of boundary objects as one of five types of knowledge articulation behaviors. He also draws on Star's (1989) work and more specifically defines boundary objects as objects inhabiting several intersecting social worlds that facilitate dialogue among multiple perspectives. Boundary objects then can serve a variety of functions: a way for one community of practice to influence another, a means to facilitate problem solving across different contexts, and a way to facilitate dialogue among multiple perspectives.

A routine is another type of tool that is salient in knowledge transfer between communities of practice. By routines we mean "stable patterns of behavior that characterize organizational reactions to variegated, internal or external stimuli (Zollo & Winter 198X, p.12)." Boundary practices are those specific routines, or stable patterns of behavior, that participants in different communities of practice use to transfer knowledge between those communities.

Administrators and teachers at Hillside and Dodge often use boundary objects and boundary practices to transfer knowledge between their respective communities of practice. The

most prominent of these that we have identified are grade level meeting agenda, the regular submission of grade level meeting minutes, the regular review of lesson plans and writing folders, and the use of artifacts in the implementation of new programs. We explore each of these boundary objects and practices separately below.

Grade Level Meeting Agenda. One boundary object used in knowledge transfer at these schools is the grade level meeting agenda. At Hillside, the principal sometimes sets the agenda for grade level team meetings even though she is not a member of those teams. In the following excerpt taken from field notes of a Professional Development day at the school, two second grade teachers, Dianne⁴ and Melissa, discuss at the morning coffee hour what their principal, Mrs. Miller, has instructed them to do at their upcoming grade level meeting:

Dianne and Melissa discuss what they are supposed to do at this morning's grade level meeting. They have been instructed to work on student portfolios for the Quality Review. Since this is something that each teacher has to do for her own class (and hence, is not a team activity), but because they have to meet as a team anyway [Mrs. Miller sets the agenda], Melissa suggests that they look through one of the portfolios that has already been done. Dianne agrees that this is a good idea (SA012100moac).

At the end of the coffee hour, Mrs. Miller makes an announcement over the intercom to remind the teachers of the agenda for their grade level meetings:

Mrs. Miller made an announcement over the intercom: "The general meeting for grades 3, 4, 5, 7, and 8 teachers involved with ISAT is now at the auditorium. All other teachers should be meeting in their teams to work on student and teacher folders for the Quality Review...Thank you." (SA012100momv)

The administration at Dodge also sets the agenda for the teachers' grade level meetings, though less formally than at Hillside. For instance, the principal or assistant principal will sometimes briefly state at staff meetings or leader team meetings what she would like the teachers to discuss at their next grade level meetings. In the following field note excerpt taken from a staff meeting, several teachers who are familiar with a new structured curriculum

distributed by the school district share what they know about it with the staff. Toward the end of the discussion the principal, Ms. Lin, urges the teachers to discuss the structured curriculum at their grade level meetings:

Then Lin turned the floor to Mrs. Corbet (the upper grade literacy teacher) who had gone to the staff development on this [the structured curriculum] and would tell them about it. Corbet stood up at her table and began, “First of all, people were really angry at the meeting because they spent so much materials on this, but basically” it’s just lesson plans aligned with state goals. Then a white female asked, “I thought this was just for schools on probation?” and another white female who had been to the staff development answered, “It’s not mandated except for schools that are on probation.” Then the first white female repeated her feelings, “For those of you who have been in CPS before, it’s just like the old punchcards” for CRTS and a “waste.” But Mr. Winston disagreed, saying, “I don’t think it’s a waste;” that during summer school it laid everything out and you can still “work creativity into place;” and “from a social studies point of view, everything is a hodge-podge today so I appreciate it;” and “They’ll add to it every year.” Corbet agreed saying, “Yes, it is a good resource,” (not a total waste), and Lin said, “It’s not mandated. We are told it is for the 1st year teachers. So how do you use it? It’s up to you.” [She then tells the teachers they] should “take some time to review and share at grade level meetings.” (CL112399moth)

In these examples, the principals set the agenda for their teachers’ grade level meetings by telling them what to do. In the first example, Mrs. Miller instructed the teachers to work on their student and teacher folders for the Quality Review. At their meeting that day, the second grade teachers did follow her instructions and share the contents of their Quality Review folders. Typically, the 2nd and 5th grade level teams at Hillside complied with Mrs. Miller’s agenda. However, the quality of the teachers’ attention to these agenda was not always high. At Hillside, the fifth grade teachers appeared to merely “go through the motions” at times when following an externally set agenda. At one meeting for example:

Kerry mentions the Read Write Well writing contest and says, “I’m supposed to share this with my team. I’m sharing with my team...here you go” and she hands Tracy a handout with contest information. That is the end of any discussion about the contest. She moves on to talk about an “Olympic Day” that is to be held at Hillside on June 6th...(SA041100moac).

⁴ All names have been changed.

Kerry, who is the team leader, gave the agenda, which was presumably set by the administration (illustrated by her saying “I’m supposed to share this with my team...”), a rather cursory treatment. This excerpt shows that the agendas may allow Mrs. Miller a surface level of influence in determining what teachers discuss in their meetings but they do not ensure that the teachers will treat those items substantively.

In the Dodge example, Ms. Lin instructed her teachers to review the district’s new Structured Curriculum in their meetings. Her request was more open-ended and less task-specific than Mrs. Miller’s directive. Usually, the 2nd grade level team at Dodge only met when absolutely necessary, particularly when they were accountable for completing a task. Unless the administration required them to produce a tangible product, they did not meet just to discuss a topic that the administration merely suggested they discuss.

In each case, the principal’s agenda for her grade level teams, whether formal or not, was an artifact that embodied the knowledge of her priorities and objectives regarding how the teams should spend their time. By setting the agenda for these meetings, each principal informs her teams of what she thinks is important for them to do. These agenda are boundary objects in that they bridge the boundary between the administration and the grade level teams. Fitting Wenger’s (1998) conception of boundary objects, these agenda are used by one community, in this case the administration, to influence the practice of other communities, the grade level teams, by directing how the teachers use their meeting time.

Grade Level Meeting Minutes. Another example of the use of boundary objects in knowledge transfer between the administration and teachers is the use of grade level meeting minutes. At Hillside, Mrs. Miller requires the members of each grade level team to sign an attendance sheet at their grade level meetings and to record the content of what they discuss.

The minutes themselves serve as a boundary object between the administration and the teachers, and the regular submission of these minutes to Mrs. Miller is a well-established routine that serves as a boundary practice between the two. The following field note excerpt is taken from a fifth grade level meeting at Hillside:

When I got to the meeting, they had me sign in on a sheet. In addition to an "attendance" list, the sheet also served as a notepad where the teachers were supposed to summarize the issues they discussed and turn it in to Mrs. Miller (Helen served as secretary)...

Then Helen asked Kerry "what else?" (did they need to cover in the meeting --Helen had written down the stuff on the movie but not the stuff I asked about the constitution and science on the go). Kerry mentioned the issue of restructuring the Friday 1/2 days. This refers to a confrontation Kerry had with Mrs. Miller about the teachers needing time to work on their lessons etc. which Mrs. Miller had been filling with inservice type things. Working together, Kerry and Helen figured out how to best "word" this, and Helen wrote as issue #2 "Is it possible to allot a portion of time to work in our classrooms in addition to staff meetings?" Then Helen suggested adding "Discussed ITBS [Iowa Test of Basic Skills]," and they added it to the list, even though I did not see them talk about it substantively (SA041399moth).

In this meeting, Helen recorded for Mrs. Miller what the team discussed. These minutes serve two functions. First, by requiring each grade level team to submit these minutes to her on a weekly basis, Mrs. Miller is able to monitor, at least on paper, what they do and how they spend their meeting time. The minutes transfer the knowledge that the grade level teams have discussed what they have been instructed by the principal to discuss. This monitoring system is another way for the principal to influence her teachers' practice. However, her use of minutes to monitor what teachers do in meetings does not ensure that they press on the issues they discuss in a meaningful way. Similar to the prior example in which the 5th grade team leader distributed a handout on a writing contest without further explanation or discussion, this excerpt illustrates the 5th grade team documenting that they discussed a potentially important issue – the ITBS – even though the researcher notes that they did not discuss it “substantively.” Thus, Mrs. Miller’s influence through this boundary practice remains at a surface level.

A second function of the minutes is to provide a means through which the teachers can air school-related concerns to the principal. In the above example, the teachers are aware that they can use the meeting minutes as a tool to communicate with Mrs. Miller. Indeed, they take that opportunity to request that she give them more classroom time on restructured days⁵. Here again, the minutes are a boundary object that serves to transfer knowledge between the teachers and Mrs. Miller. Specifically, the minutes inform the principal of a school practice the teachers would like to change. In this instance however, the minutes are a means through which the teachers can attempt to influence the principal's practice. Thus, the minutes enable a two-way exchange of influence.

Although toward the beginning of the school year the principal at Dodge introduced a system whereby teams would record grade level meeting minutes in a special binder (each grade level had one) to keep absent teachers informed, this practice was less salient than at Hillside. However, the 2nd grade team at Dodge did write notes to the administration several times. For example, the 2nd grade team at Dodge wrote the assistant principal, Mrs. Tinley, to propose a change in their newly implemented Behavior, Objectives, and Academic Excellence (BOA) assemblies:

Then Sumner asked if anyone knew when the next BOA assembly was. Someone gave the date and Madden said it would be better if each class had their own assembly in their own room. They all seemed to like this, and Connelly said, "Well I'll just right a letter...." Then Connelly stood up to get a piece of paper to write the letter, and said with a louder, agitated voice (raised tone) that "they" had taken away 3 hours of their time (I think this is in regards to the staff development day scheduling). Then Connelly had the piece of paper but Sumner took it (she's the secretary) and started writing the letter about the BOA to Tinley, suggesting separate BOA assemblies in each 2nd grade classroom. They all seemed in agreement, and Rachel said it was too big last time, and that the kids didn't even know the other students, so it didn't have meaning, and everyone seemed to agree. Mad said that this way, Tinley could come in any time and they could just stop whatever they are doing and have the assembly then and there. Sumner wrote and said aloud, "Come at your convenience" and Moore added

⁵ Restructured days are days on which students are dismissed early in order to give the staff more time for professional development, meetings, or classroom preparation.

with a laugh “or don’t come at all, we don’t care,” and I think they all laughed. Then Sumner passed the letter around, telling them all to sign it indicating “agreement,” and they did (CL032900moth(2nd)).

This note is a boundary object that the teachers use to communicate with and influence the administration. The fact that each member of the team signs the letter to ‘indicate agreement’ illustrates the team’s desire to appear unified, perhaps giving them more power to influence the assistant principal. Indeed, the assistant principal did agree to the change.

Lesson Plans. Another example of a boundary practice used at Hillside to transfer knowledge between the teachers and the administrators is the weekly submission of lesson plans. Each teacher is required to submit to the principal her lesson plans for the following week. The lesson plans are a boundary object that transfers to the principal the knowledge of what the teachers plan to do in the classroom. Similar in function to the grade level meeting minutes, the lesson plans allow Mrs. Miller to monitor, at least on paper, the teachers’ classroom practice. In particular, the plans embody the teachers’ knowledge of the curriculum (Shulman’s curriculum knowledge) and they allow Mrs. Miller to oversee the content they are teaching. They also illustrate the teachers’ knowledge of a specific lesson plan-writing procedure (Shulman’s knowledge of educational contexts).

The following excerpts from a couple of 5th grade level meetings illustrate the salience of this routine as a part of the teachers’ practice:

Then Helen applauded Tracy for being so on top of her lesson plans, explaining that she was behind, (though Tracy had also gotten a “bad” note from Mrs. Miller about being late on her plans)... [Later on in the meeting after the teachers have decided to implement a new abstinence program]. Maria raised a concern about how to write the new program up in their lesson plans. Kerry answered her in a way that made it sound like a silly question. She said rather dramatically and impatiently, “just put health, Maria!” (SA042099moac).

At another meeting,

Maria and Sonya began a side conversation that went back to the science issue they had been talking about earlier. I asked Sonya about the science notebook. It is called “Structured Curriculum Lesson Plan”. She told me that there is one for Reading, Math, Science, and Social Studies and that it is produced by the Board of Education. She seemed to like the Lesson Plans a lot. She said that you can “use any book” to teach the lessons out of the plan. Tracy asked Sonya directly, “What did you put on your lesson plans?” Sonya explained that she looked through the curriculum, “saw what I wanted to use, and put it down (SA110299moac).”

The teachers’ weekly submission of lesson plans combined with the principal’s feedback in the form of interpersonal notes constitutes a boundary practice that allows the principal to monitor what teachers say they are doing in the classroom. The above examples illustrate the teachers’ concern with writing their lesson plans correctly, indicating that this is a routine they take quite seriously. That they write their lesson plans ‘correctly’ however, does not mean that they necessarily follow these plans when they teach. Thus, this boundary practice transfers the teachers’ knowledge of the content and curriculum for which they are responsible but does not ensure that they teach it. This practice also illustrates their knowledge of the rules that outline how to write lesson plans correctly, a procedure that helps to maintain the organization (Shulman’s knowledge of educational contexts).

At Dodge, the teachers are also required to submit lesson plans regularly to the administration. However, because the teachers generally do not discuss writing up and submitting their lesson plans and do not appear too concerned about them, this boundary practice does not appear to be as salient to their work.

Writing folders. Another boundary practice that is used to transfer knowledge regarding the content of teaching at Hillside is the use of writing folders. Every month from October to April, teachers submit to Mrs. Miller a folder that consists of one composition written by each student in the class. Mrs. Miller reads all of the writing samples in each folder and subsequently

provides the teachers with written feedback. In the following interview, Mrs. Miller explains her rationale behind this boundary practice:

You know, I can – I can tell a lot of what’s happening in the classroom by just reading folders and providing feedback to teachers. I can see people who maybe need to work a little on certain things.... So I thought it was a good way for me to get kind of a snapshot of what’s happening and what people are doing in this school. It forced teachers to actually teach writing as a subject and not just as a homework assignment and encouraged them to use the writing as an integrated thing, not as a stand-alone (Interview, 04/06/00).

Mrs. Miller makes it clear that by reviewing the writing folders she wants to have an impact on what the teachers do in their classrooms with respect to teaching writing. If teachers do not comply with her requests, then this will be reflected in their summative evaluations:

Well, I write notes to every single classroom every single month. And some of it, you know, I try to have it be constructive criticism. I try to give specific things that maybe the class might want to work on and hopefully the teacher will say, “Well if the class needs to work on it, that probably means I need to work on it.” And certainly, you know, when – when people come in for their final evaluations or that if I’ve written a note – because I keep copies of the notes. I have them on file. When I do evaluations, you know, if people – if I’m continually writing to a teacher, you know, “please work with your children on making sure that their paragraphs are longer than one sentence” and then at the end of the year they’re still writing one sentence paragraphs, I think this is a person who doesn’t get the message or is not really interested in improving themselves or their children. So it figures into the final evaluation – into the summative evaluation. But – and, you know, if someone’s having a real difficulty, I have no problem with talking to them personally about it (Interview, 04/06/00).

This boundary practice allows Mrs. Miller to transfer two types of knowledge to her staff. To begin with, she communicates to them that one of her main priorities in the school is the teaching of writing (for no other subject matter does she regularly give specific, content-related feedback). This type of knowledge falls under Shulman’s knowledge of educational contexts – Mrs. Miller’s emphasis on teaching writing as a subject constitutes a school-wide context for instruction.

Through written feedback she also transfers to the teachers content-specific knowledge related to writing. For example, on a student writing sample from Kerry’s class, Mrs. Miller had

written, “Needs more details. Paragraphs should be 3-4 sentences. Watch your sentences. Start with a capital letter and end with a period.” On another sample she had written, “Needs work on support and spelling corrections.” Through these comments Mrs. Miller underscores the knowledge that a good paragraph contains more than one sentence and supporting details as well as correct spelling and grammar.

This boundary practice does appear to influence how the teachers approach writing. In an interview, Kerry referred to Mrs. Miller’s feedback and how she was addressing some of the issues about writing that Mrs. Miller had raised:

I switch my whole day around so they get – they get almost an hour to work on this because I realize all these different issues and problems that the kids have because I can’t write the stories for them. I have received notes from Mrs. Miller. We have to turn in compositions monthly.... But that is what I’ve had to change in my approach this year is giving them more time to think, more time to work, more time to review the process. You know, review the criteria. You have to have this, this, and this. You have to have detailed sentences. Blah, blah, blah. More time. That’s what I’ve had to do (Interview with K.D., 05/09/00).

This excerpt illustrates how the writing folders (Kerry’s reference to “notes from Mrs. Miller”) have in fact had an impact on how she teaches writing. She recognizes the importance that Mrs. Miller places on writing and has devoted more time to it this year in order to “review the criteria” for good writing with her class.

In contrast, the principal at Dodge does not have a direct hand in subject-specific instructional matters and therefore does not have an equivalent boundary practice in place to monitor any of the subject areas.

Boundary Objects for New Programs. Administrators also use boundary objects to aid in the implementation of new programs or school procedures. This phenomenon was particularly prevalent at Dodge due to the ‘newness’ of the administrators and their desire to develop their own vision and ways of doing things. The implementation of one new program was particularly

salient throughout the year – Mrs. Tinley, the assistant principal, introduced the concept of the BOA (Behavior, Objectives, and Academic excellence) assembly at a staff meeting in November. The purpose of the BOA assembly was to recognize students who exhibit good behavior, as part of ‘character education.’ As she introduced the concept at the meeting, Mrs. Tinley provided the teachers with packets of materials that delineated the content of the program and highlighted the criteria on which the students would be evaluated:

Mrs. Tinley continued on the BOA assembly, explaining that she would handle the "behavior" part. Then she explained that she had put together a packet about behaviors for grade levels: a packet on "Line Basics" and "Cleaning up after Yourself" for K, 1, and 2, a packet on "Hallway Behavior" for 3, 4, and 5, and a packet on "Respecting Authority" and "Accepting the Consequences" and "Respecting the Rights of Others" for 6, 7, and 8... . Then Tinley stated, "I'm not trying to give you a new lesson to teach," but instead "we should approach this as a philosophy" and "I know this seems strict" but school is like driving a car – there are rules you have to follow and "these are all things we have to abide by," and kids need to learn there are "requirements whenever we are functioning in society.... So then Tinley passed out the packets to the team leaders of each grade (CL111699moth).

The various packets outlining appropriate behaviors for the different grade levels constitute a boundary object between the administrators and the teachers. In this case, the artifact served as a repository of knowledge in that it stored knowledge about the content of the program and enabled Mrs. Tinley to transfer that knowledge to her staff. This example is just one of several cases in which the administration used boundary objects to introduce new programs or procedures. In other cases, boundary objects were new forms that the administrators introduced primarily for record-keeping and organizational maintenance. In those cases, the forms transferred knowledge of school procedures, or new educational contexts.

Staff Bulletin. Finally, the administration at Dodge distributed a weekly “staff bulletin” to keep the staff informed of school-related business. Sometimes the administrators would refer to the bulletin during staff meetings:

Then Lin referred them to the weekly staff bulletin, highlighted the points on the front page, and then pointed out to the teachers a letter from CPS in the bulletin about homeless education (CL110999moth).

At another meeting:

Lin was now through the agenda items, and she said, “Now I asked you to bring the staff bulletin down with you so we can go over it,” and she rapidly pointed out items which were not on the agenda. When she got to number 9 on the bulletin, “Procedures for Morning Exercises (the Pledge of Allegiance and the National Anthem),” she asked the teachers to make sure their student representatives arrived in the main office in plenty of time.... Then Lin began to go over two forms in the bulletin...(CL110299moth).

Although a lot of the bulletin content came from the administration, Mrs. Tinley encouraged teachers to contribute content as well. At a leader team meeting she announced:

“The bulletin is to share info as a whole staff,” so teachers could include things there as well (CL031300moth).

Indeed, some teachers did contribute items to the bulletin, particularly regarding upcoming grade level events. Overall, the content of the bulletin ranged from reminding teachers of regulations regarding grade books to informing them of due dates for a variety of forms as well as upcoming school events. By codifying and transferring knowledge of school happenings, events, rules, and procedures (i.e. knowledge of educational contexts), the staff bulletin served as a boundary object between many communities of practice.

Summary. The above examples illustrate the use of boundary objects and boundary practices to transfer knowledge between different communities of practice. Administrators at Hillside and Dodge use a variety of these artifacts and routines to give and to get knowledge from their teachers for the purpose of influencing their practice. Administrators in both schools transfer knowledge of what they want the teachers to do in their grade level meetings by formally or informally setting the agenda for those meetings. Further, at Hillside, Mrs. Miller is able to monitor her teachers’ practice by requiring them to submit minutes of what they discussed at

their grade level meetings and by regularly reviewing their lesson plans. She also specifically influences the teaching of writing through the regular review of writing folders. At Dodge, the administration uses boundary objects to transfer knowledge about new programs to the teachers. The teachers at both schools also have boundary objects that they use to try and influence the administrators, namely the interpersonal notes they write to propose changes to standard operating procedures. Finally, the staff bulletin at Dodge allows many different communities of practice to share knowledge across their boundaries.

An interesting pattern emerges in the types of knowledge that are transferred to teachers through the use of boundary objects and practices. The grade level meeting agenda coupled with the minutes, the teachers' submission of lesson plans, the forms that embody new programs and procedures, and the staff bulletin all transfer knowledge of educational contexts (Shulman, 1987). Specifically, each of these boundary objects is used to transfer knowledge needed for organizational maintenance – knowledge of school rules and procedures as well as of the administrators' goals and priorities. Therefore, these boundary objects have little to do with knowledge that is directly related to classroom instruction such as general pedagogical knowledge, pedagogical content knowledge, or content knowledge. The only boundary objects that did transfer knowledge specifically related to instruction are the writing folders at Hillside and Mrs. Tinley's BOA packets at Dodge. Both transferred knowledge of content – through the writing folders Mrs. Miller transferred content knowledge of writing and through the BOA packets Mrs. Tinley transferred content knowledge of a new character education program. Interestingly, the administrators did not use boundary objects to transfer instructional knowledge related to anything other than content. So when the administrators did use boundary objects and practices to transfer knowledge that is instructional in nature, that knowledge related to *what* to

teach rather than *how* to teach it. Furthermore, the transfer of content knowledge via boundary objects was not as common as the transfer of knowledge about organizational maintenance.

Knowledge Distribution within Communities of Practice: The Role of Artifacts and Routines

In contrast to the prevalence of routines for knowledge transfer *between* communities of practice highlighted above, for knowledge transfer *within* teacher communities (i.e. grade level teams), teachers have few routines in place. Their primary routine for transferring knowledge within the grade level community was to meet regularly as a team. At Hillside, teachers met once a week and used that time to discuss a variety of issues and at times to distribute knowledge to team members. At Dodge, the 2nd and 5th grade level meetings were not as routine – they typically met only when the administration required them to perform a particular task.

In addition, artifacts are less prevalent and are used for different purposes in the transfer of knowledge within these communities when compared to knowledge transfer between communities of administrators and teachers. The artifacts that teachers do use to transfer knowledge within their communities are typically instructional materials. These artifacts are used to ground teacher decision-making regarding the selection of instructional materials or the planning of lessons and activities. In the following excerpt from a grade level meeting, the second grade teachers discuss which books they should order for their classrooms:

Marita says, “we don’t have many things on transportation to read.” Marita mentions a book on the *Titanic* that she has read with her class. Dianne asks her if she is referring to a specific book that Dianne knows about. This particular book she is thinking of is difficult for the students. Marita replies that it is not the same one – it is different and it is really good. She offers to go get the book out of her classroom to show them and when the others are interested to see it, she leaves to retrieve it. They continue their discussion while she is gone. Dianne holds up a book in front of her to show the group. It is called *The Cat Who Wore a Pot on Her Head*. She smiles and says enthusiastically, “I read it with my class and the kids love it”.... Marita returns with a copy of the *Titanic*. She shows it to them and they agree

that it would be good to use. Dianne says, “this we’ll do when we do transportation.” Then Melissa shows Marita Dianne’s *cat* book and says, “what about this one?” (SA032100moac(2nd))

In this meeting, the second grade teachers use copies of the books they are recommending to ground their conversation about which books to order for the grade. Their conversation focuses on which books they might include in the thematic units. The teachers refer primarily to the content and relevance of the books they might select. The conversation using these artifacts remains around content for the most part – what topics certain books cover. The teachers do not discuss how they might use those books to teach specific subject matter content. Overall, the type of knowledge teachers are sharing is knowledge of materials. As artifacts, each book embodies the knowledge of what it is about and how it is relevant to the curriculum. Using the book as a visual aid helps the teacher who is presenting it to transfer her knowledge of the book to her colleagues who are not familiar with it. The teachers use these artifacts to facilitate their discussion of the content of classroom reading materials.

In a similar example, the second grade teachers at Dodge use samples of math textbooks to frame their discussion of which new mathematics series to adopt. In the following excerpt, the teachers argue the merits of one series – the “red” series – versus another – the “blue” series.

Then, in support of the red book Moore said she liked the word problems, and with the blue book, “You would have to supplement.” Sumner replied, “But we have what we’ve been doing,” and Moore responded, “But in this [red] one the word problems are right on the page,” which she likes. [She holds up a page up for effect.] But then Sumner pointed out another blue material that had a “problem of the day” which was a word problem; [something like 186 word problems—I think Mann handed this to Sumner during Moore and Sumner’s exchange]. Then Moore said, “6 to 1 majority rule, I’m the odd man out as usual,” and she laughed (CL032900moth).

In this discussion, both Ms. Moore and Ms. Sumner refer to particular mathematics series materials in order to advocate their respective positions. The materials are artifacts that embody the specific content and structure of each series. Further, they serve as evidence to support each

teacher's position. By referring to the materials themselves, each teacher transfers knowledge of the content of program materials to her colleagues. Again, the teachers share knowledge of materials. These artifacts help to ground their discussion by providing a common reference point.

In addition to using artifacts in the selection of instructional materials, teachers also use artifacts to plan lessons and activities. In the following excerpt from a grade level meeting at Hillside, the second grade team uses samples of classroom activities from past years to aid them in planning lessons for their next thematic unit:

At this point in the meeting, Melissa and Dianne in particular show examples of activities that they might consider doing with their students for the fourth quarter. [The 2nd grade team always teaches the same units at the same time and I think they use a lot of the same activities.] Dianne shows them a multiplication tables activity – a sample that one of her students did in a past year. She flips through the multiple pages that are attached to construction paper and says, “Heather did this on the computer.” [Unfortunately, I couldn't really see it from where I was sitting.] Heather adds, “I loved that [activity]. That was good.” Dianne pulls out another activity from her pile of stuff. She calls it “the fisherman and his wife's pocketbook” and says, “they did this last year. That's always good.” The others agree. Then she says, “don't forget...we also do ‘fish do the strangest things’” as she unfolds a fairly large poster one of her students had made to show them an example.... Melissa has been looking through some of her stuff and suggests an activity she finds. The activity has something to do with drawing a Venn diagram on a story about fish. Then she pulls something else out to show them and says, “here is our book report...” (SA032100moac(2nd)).

To plan their “fish unit”, Dianne and Melissa pull out artifacts of past lessons, or samples of student activities. These artifacts serve as repositories of instructional knowledge in that they supply a common reference point and are a resource for solving problems (Carlile, 1999). In this case, they aid in solving the problem of planning and coordinating units across the 2nd grade classrooms. Each sample activity embodies the instructional purpose and content of the activity, as well as what the activity entails for both teacher and students. By grounding their discussion in these artifacts, the teachers are able to avoid renegotiating each time the content and

pedagogical content of recurring thematic units. These artifacts serve as a visual aid to trigger the teachers' knowledge of what they have done in the past to teach certain curricula. They also help to ensure that the teachers have a shared understanding of the activities they are discussing. Only the 2nd grade team at Hillside used samples of student activities to plan and coordinate their classroom practice.

At times, the teachers transferred pedagogical content knowledge, or how to teach a particular concept, without the use of an artifact. For example, one of the fifth grade teachers at Hillside explained to her teammates her idea to combine educating her students about the census with teaching them how to write a persuasive essay:

Tracy says that she similarly tells her students that the census is used for things like parks and roads. She told them that if they don't fill out their forms, there won't be "enough swings and there will be bumpy roads." Then she describes how she is having her students "write a persuasive essay to their parents to persuade them to fill out the form." [Persuasive writing is one of three types of writing that the teachers are required to teach.] Kerry exclaims enthusiastically, "that's a good idea!" Sonya nods and affirms it as a good idea by repeating, "persuasive essay" as she writes it down.

Instances such as this one in which teachers shared pedagogical content knowledge with their team members were not too common.

When teachers share knowledge within their grade level communities regarding outside instructional resources, school rules or procedures (knowledge of educational contexts), or coping with the job (wisdom), they often do not codify that knowledge, or represent their understandings of these aspects of their work in artifacts such as written memos or manuals (Zollo & Winter, 19??). Typically, these types of knowledge are shared simply through verbal exchanges. In the following excerpt from a grade level meeting at Hillside, a fifth grade teacher shares her knowledge of an instructional resource – in this case a field trip opportunity – with her colleagues:

Tracy announced that she had yet another program to bring up. Maria called her the “field trip lady” because she was organizing so many. Tracy brought up another program for the kids in January – a play put on by “The Giving Tree.” She described it as a play that deals with conflict resolution and issues of self-esteem and it is about 5th graders. The teachers liked that it was about their grade.... Tracy said, “it costs \$300 and Mrs. Miller said she would pay for it” (SA110299moac).

In this example, Tracy simply made a verbal announcement to her team about a field trip opportunity. She transferred her knowledge of this extra-curricular resource (knowledge of educational contexts) without the use of an artifact.

Similarly, when transferring knowledge of how to cope with job-related issues, teachers do not rely on artifacts. In the following excerpt from a grade level meeting at Hillside, the fifth grade teachers offer a distraught Tracy some advice regarding how she should cope with a student who has been returned to her classroom after being suspended for threatening her:

Tracy continues, “He [the suspended student] hasn’t said anything. I haven’t even been over there [near to his desk].” Kerry says, “You are entitled to these feelings.” Sonya suggests, “Take him in the hallway – whatever your feelings are you need to let him know. You need to say to him, ‘I’m not pleased you’re back in my classroom.’ They need to know that we get upset...we get frustrated.” Tracy replies, “I don’t want him in my class.” Sonya suggests, “well, tell him, ‘I don’t have a choice and I’m not happy about it’” (SA041100moac).

Sonya, the most veteran teacher on the team, gave Tracy advice for how to cope with having a student who physically threatened her back in her classroom. Sonya’s advice comes out of the wisdom she has gained from her years of practical experience. According to Shulman (1987), wisdom is the least codified source of knowledge for teaching. The fact that this instance of knowledge (or more specifically ‘wisdom’) transfer did not involve the use of an artifact supports his argument that wisdom is not likely to be codified.

Finally, when teachers transfer knowledge of school rules and procedures to their colleagues, they often do so without the use of artifacts. At Hillside for example, teachers will

often ask their teammates specific questions about how to write up their lesson plans. In the following excerpt, Ms. Gutierrez is unsure of how to write up a new abstinence program that the fifth grade team has just decided to implement:

Ms. Gutierrez raised a concern about how to write the new program up in their lesson plans. Kerry answered her in a way that made it sound like a silly question. She said rather dramatically and impatiently, “just put health, Maria!” (SA042099moac).

At another grade level meeting, the fifth grade teachers discuss the “Structured Curriculum Lesson Plans” provided to them by the school district. The Plans contain suggested lessons that cover a wide variety of subjects. Tracy is unsure of how to write up these in her lesson plans:

I asked Sonya about the science notebook. It is called “Structured Curriculum Lesson Plan”. She told me that there is one for Reading, Math, Science, and Social Studies and that it is produced by the Board of Education. She seemed to like the Lesson Plans a lot. She said that you can “use any book” to teach the lessons out of the plan. Tracy asked Sonya directly, “What did you put on your lesson plans?” Sonya explained that she looked through the curriculum, “saw what I wanted to use, and put it down” (SA110299moac).

In both of these examples, Kerry and Sonya transfer the procedural knowledge of how to correctly write up their lesson plans to their teammates without the use of an artifact.

In sum, artifacts and routines are less prevalent in the transfer of knowledge within grade level communities. Unlike the administrators, teachers are not in the business of monitoring or shaping other teachers’ practice. Furthermore, administrators at large schools such as these need ways to manage and monitor large numbers of teachers. Boundary practices and routines allow administrators to transfer knowledge to large numbers of people more efficiently. Teachers on the other hand, do not face the same responsibilities or constraints. Therefore, they do not have many artifacts or routines in place to transfer knowledge within their teams.

The artifacts that are in fact used to transfer knowledge within these teacher communities are typically instructional materials or sample activities that teachers refer to when choosing classroom materials or planning lessons. The types of knowledge transferred through the use of

these artifacts are knowledge of materials and pedagogical content knowledge. Artifacts are not always used in the transfer of pedagogical content knowledge, however. Teachers sometimes transfer this type of knowledge simply by verbally sharing it. In contrast to the administration who transfers instructional knowledge of *what* to teach, it is the grade level community that provides a context for the transfer of knowledge of *how* to teach.

There are many other instances in which knowledge is transferred within grade level communities without the use of artifacts. Specifically, artifacts tend not to be used when teachers transfer to their colleagues knowledge of educational contexts – specifically knowledge of outside instructional resources and school rules and procedures – or wisdom.

Knowledge Distribution: The Role of Boundary Spanners.

Clearly, artifacts and routines play a role in the transfer of certain types of knowledge between and within communities of practice in schools. However, another mechanism through which knowledge is transferred in schools is the work of a specific type of actor, or boundary spanner. Boundary spanners are individuals who serve as a link between two different communities in which they participate. In other words, they span the boundary between communities of practice.

Boundary spanners play a key role in the transfer of knowledge between communities of practice at both Hillside and Dodge. In many cases, the role of the boundary spanner is to serve as a conduit of knowledge and information between two communities of practice. This role is often explicit and formal. At Hillside for example, the Professional Personnel Advisory Committee (PPAC) is a teacher committee that consists of one teacher representative from each grade level. The committee is structured so that each member represents the interests of her grade level team. In their role as grade level representatives, these boundary spanners transfer

knowledge between the community of practice of the PPAC and that of the grade level teams. Specifically, the PPAC members regularly report back to their teams whatever business the PPAC has discussed. In the following excerpt from a grade level meeting, Dianne, the second grade representative on the PPAC, shares with her teammates the issues that the PPAC discussed at a meeting earlier in the day. Among other things, the PPAC members had discussed how the school was not in compliance with certain components of the School Improvement Plan (SIP):

Dianne quickly moved to the next item of business from the PPAC meeting. She pulled out a copy of the School Improvement Plan from a folder she had and turned to a specific page. She pointed to the page and explained that the pullout program for students at risk is not in compliance with the plan and that there had been complaints. She said that they are going to have to make amendments to the plan so that they are in compliance. She said, “The 3rd grade is not included in this program although the school improvement plan says they should be.” Dianne talked about Heather [the Reading Specialist] and said, “There is only so much of Heather to go around in one day.” Dianne also commented that the bilingual program is not being serviced at all.... I don’t know what they expect...how thin do we want to spread her?” She continued on about the SIP and a provision about reduced class size. She said, “Some of us are and some of us aren’t [benefiting from reduced class size]” (SA101999moac).

In this example, Dianne fulfills her formal role as grade level representative and boundary spanner between the PPAC and her grade level team by reporting on what the PPAC discussed at their latest meeting. She serves as a conduit of knowledge between these two distinct communities of practice. In this case she shares knowledge of the status of certain components of the SIP, part of the educational context for the teachers’ work.

Similarly, Maria, who is the fifth grade representative on the PPAC, shares with her teammates her knowledge of some monetary resources the teachers now have to buy instructional videos:

Maria announced that she had attended the PPAC meeting in the morning and she reported back to them that the team has \$750 to buy videos, or \$150 per teacher. She mentioned that they will have to be kept in the library. The teachers did not like this idea.... Someone mentioned how it is a problem to count on using a video and then to find that another teacher has checked it out of the library (SA110299moac).

Again, as the fifth grade representative on the PPAC, Maria spans the boundary between the PPAC and her team. The knowledge of budgetary resources for instructional materials, which falls under knowledge of educational contexts, is transferred from the PPAC, through Maria, to the fifth grade teachers. On a different day, Maria again shares with her team what the PPAC had discussed at a recent meeting:

Maria reports that the PPAC reviewed the “analyses of current conditions” and they “invited the principal to visit with us.” She explains that one of the main issues at the meeting was how to deal with staffing when teachers leave during the school year. She lists the teachers who have left this year due to pregnancy leave and other reasons, and says this is why it is an issue. She lists several names, a couple of which I don’t know. She says they were concerned with “how do you organize so that students don’t lose quality learning time and you don’t interrupt the school curriculum.... The question was, do we have a plan for replacing staff who take leave.” She reiterates the situation with the librarian who retired and explains that Mrs. Miller advertised the position early on because she knew the librarian was leaving. However, some of the other teachers who left, they didn’t expect to leave. Maria says, “I gather she’s doing the best she can. Like she says, with so many positions open, it’s hard to find quality people.... When she advertises and she can’t get people, then she uses what she has here....” I think it is Kerry who points out to Carlos that Mrs. Miller is retiring next December. Maria adds that the teachers are worried what will happen when she leaves. She continues, “the PPAC wants to make sure things are left in a real good way. She [Mrs. Miller] wants to leave with things feeling positive. We need to clarify a lot of things before she goes.”

Thus, Maria transfers knowledge of particular staffing issues to her team. Later in the meeting, one of her teammates shares a concern that she would like Maria to report back to the PPAC:

Kerry turns to Sonya and asks, “Would you like to raise your issue?” Sonya replies that her issue has to do with detention and home suspension. It is something she wants Maria to report back to the PPAC. She is upset that when students serve detention or suspension, their “teachers are interrupted from teaching to gather materials that they want yesterday.” [I think “they” refers to the woman in charge of the detention room.] She describes how this woman comes up to the classroom and says, “I need work now!” even though the teacher is in the middle of teaching. Sonya says, “Who’s being punished here, you or the child?” Kerry adds, “it’s extra work” to come up with assignments for kids to work on in detention. Sonya says, “something has to be done.” Kerry says, “the issue is the intrusion into your class time.” Sonya adds, “As if this takes precedence over what you’re doing in the classroom. There should be something [work] in the detention room that can be utilized until the teacher can provide something....” Kerry says, “Something needs to be changed.” Sonya further complains about how the teachers often don’t know why their students are pulled out

for detention or suspension and they often don't know in advance that they will be pulled out. She says, "We need to be notified before." Tracy adds that she has to ask her students why a particular student is in trouble. She agrees that it is not right for the teachers to be in the dark about it.... Sonya says the system "Just needs some fine tuning." (SA032100moac)

In all of the above examples, Dianne and Maria serve as boundary spanners between their grade level teams and the PPAC. As formal participants in both communities of practice, they are in the position to serve as a sort of regular conduit of knowledge and information between these communities. The direction of this transfer of knowledge is typically from the PPAC to the grade level teams. However, there are times when the reverse is true. Interestingly, the knowledge that is typically transferred via these boundary spanners is knowledge of educational contexts – for instance, the status of a reading pullout program, school budgetary concerns, staffing issues and procedures for filling mid-year staff vacancies, and school detention procedures. Finally, the role of these boundary spanners is a formal one – that is, it is part of their formal responsibilities as grade level representatives on the PPAC.

Dodge also has formal boundary spanners in place to aid in knowledge transfer between different communities of practice. To facilitate communication with the administration, Ms. Lin established a Leader Team, consisting of a representative from each grade level, the principal, and the assistant principal. Excerpts from several meetings illustrate the role of the Leader Team members as boundary spanners between the Leader Team and the grade level teams. In the following excerpt from a Leader Team meeting, Mrs. Tinley asked the teachers to get feedback from their grade level teams regarding the schedule:

The next item on the agenda was teacher input on class scheduling, and Tinley recommends coming up with ideas about this through their grade level meetings. She says, "I'd like to know by the 6th of June" about "any comments, any input" from hall patterns to lunch. Someone problematizes this, saying that they didn't think much could be done. Tinley raised her voice (signaling frustration to me) but then said while varying her voice (trying to take off the edge?), "If it's possible, we do it. If it's impossible, we don't. But we can't do it if we don't know" (CL050800moth).

Mrs. Tinley asked the Leader Team members to discuss the schedule with their colleagues and then report that information back to her. She uses their positions as boundary spanners as a way to gain knowledge of what is working and not working with respect to the current schedule, or knowledge of this educational context.

A second excerpt illustrates how the Leader Team members do in fact transfer knowledge from the Leader Team meetings to their grade level team members. One of the major tasks the Leader Team initiated in the spring was to restructure classrooms so that students would be grouped heterogeneously rather than homogeneously for the following school year. Their plan was to have the members of each grade level work together to assign their current students to classes for the following year. (For example, the second grade team was responsible for assigning all of the current second grade students to their classes for the third grade). To help the teachers carry out this task, Mrs. Tinley designed two forms – a tally sheet and a roster sheet. In the following grade level meeting, Mrs. Connelly, the 2nd grade representative on the Leader Team, explains to her teammates how to use these forms:

Then Connelly holds up the tally sheet from the Leader Team meeting, shows it to them, and says, “This is the last form.” Then she holds up the roster and says, “This is the 2nd to last form.” Finally, she holds up the sheet she made and says, “This is how we’re going to get to” the other forms. Each of the forms has a “race/ethnicity” category, so Connelly goes over the codes for race/ethnicity, apologizing saying, “I know I’m going fast, this is just so you know what we’re doing,” and referring to the sheet she made up she said, “So like I said, we can cut these up, put all the girls in one pile, boys in another”.... Then Moore says, “Okay, so we’re not even going to worry about this list right now?” referring to the roster sheet, and Connelly replies, “right.” Then Connelly explains, “This we received a month ago, and it was said it was a rough draft. Now, this is what we’re doing” (CL051000moth).

In this example, Mrs. Connelly serves as a formal boundary spanner between the Leader Team and her grade level team. By virtue of her dual participation in these communities of practice, she transfers the procedural knowledge of how to carry out this restructuring task from the

Leader Team to her colleagues. As illustrated in the above examples, the knowledge that grade level representatives transferred between the Leader Team and their grade level teams was typically knowledge of educational contexts, specifically, knowledge pertaining to organizational maintenance.

Sometimes, teachers represented their schools at professional development workshops or meetings that took place outside of the immediate school community. Upon their return they would share what they learned with their colleagues at the school. These teachers served as boundary spanners between various communities of practice outside of the school and the school community itself. However, their role as boundary spanners was less formal and less prevalent than that of formally recognized grade level representatives on the PPAC and Leader Team. This less formal type of boundary spanning occurred as opportunities presented themselves. In the following staff meeting at Dodge, the school's technology coordinator shared information with the staff that she had learned at an outside professional development workshop:

Lin introduced "Caroline Reed", the technology coordinator, who was going to share with the teachers what she had learned at the technology workshops at Navy Pier during the staff development. Reed began by holding up some brochure about "acceptable use" on the internet.... Then Reed started to talk specifically about the workshop she went to which was led by "William Conrad from the State Board of Education. I was crazy enough to go to a meeting on standards!" and she laughed, and so did one other teacher, but no one else did. Reed went on to say she really liked the meeting, and that all of the standards and curriculum and lesson plans were going to be put online, and it was very user- friendly. There were "Even ISAT practice packs" and "He's even talking about the kids being online...." Then Reed said "Another one I went to was NASA," and there was a free internet site with fee stuff for schools (CL110999moth).

In this example, the technology coordinator spans the boundary between an outside community of educators interested in technology and the Dodge school community. By doing so, she transfers knowledge of technology-related resources that support classroom instruction.

In sum, boundary spanners play a key role in the transfer of knowledge between communities of practice in schools. These boundary spanners typically transfer knowledge of educational contexts – more specifically, knowledge pertaining to organizational maintenance or in some cases, resources. Sometimes this role is a formal part of one’s responsibilities, as in the case of the grade level representatives on the PPAC and the Leader Team. At other times, the role of boundary spanners is less formal, as in the case of individuals who from time to time attend meetings or workshops outside of the immediate school community and bring in outside knowledge. Boundary spanners are a potentially powerful means of transferring organizational knowledge. For this paper we have focused primarily on those individuals who span the boundaries of communities of practice within schools. However, we recognize that school leaders, including administrators *and* teachers, play a key role in spanning the boundaries between the school community and outside policy or professional communities (Coburn, 2001) and in the future we plan to expand our work to include the boundary spanning role of these leaders.

Conclusion

We have illustrated the role of artifacts, routines, and actors in the knowledge transfer process at two elementary schools. Specifically, we have found that administrators use more artifacts (boundary objects) than teachers do. They use meeting agenda and minutes, lesson plans, writing folders, forms for new procedures, and staff bulletins to transfer knowledge of educational contexts and in rare cases, content knowledge. The teachers do not use many artifacts when transferring knowledge within their grade level teams. The artifacts that they do use are typically instructional materials and samples of student work that serve to transfer

knowledge of curricular materials and pedagogical content. Teachers sometimes transfer ideas for teaching particular content without the use of artifacts, and they typically transfer knowledge of educational contexts (specifically knowledge of resources) and wisdom to their colleagues without the use of artifacts.

Our findings show that in the formal meeting settings in which we observed, and embodied in the boundary practices in place, the overwhelming type of knowledge that individuals shared was knowledge of educational contexts. These meetings and routines largely enabled teachers and administrators to transfer knowledge pertaining to organizational maintenance. That these tools were not used to transfer knowledge that more directly relates to instruction (e.g. general pedagogical and pedagogical content knowledge) begs the question of how these types of knowledge are transferred. In light of the critical role that knowledge plays in instructional innovation, this question will be imperative to address in the future. In addition, the particular formal meeting settings we analyzed are just one context in which knowledge is potentially shared. Other highly relevant formal settings might include professional development meetings and workshops. For this paper however, we limited our analysis to knowledge transfer that occurs within the school community – we did not extend that analysis to include transfer beyond the boundaries of the school itself. Because professional development at Hillside involved communities beyond the school, and Dodge did not engage in professional development activities at all, we did not include the professional development context in our analysis of knowledge transfer within schools. Finally, it is quite probable that individuals also transfer knowledge in informal contexts such as conversations that take place before and after school or at other times throughout the day. To fully understand how knowledge is transferred in

schools, we will need to explore this process as it occurs in both formal and informal contexts, as well as within and beyond school boundaries.

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