Analyzing Teachers' Professional Interactions in a School as Social Capital: A Social Network Approach

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Background/Context: *Researchers have proposed a number of lenses for analyzing teacher professional communities in recent years. These lenses have been useful in describing key dynamics of professional communities; however, none provides a compelling approach to how to integrate data from the school as a whole with case study data on individual interactions to create a coherent account of the structure and dynamics of teacher professional communities.*

Objective: *Our objective was to present and illustrate the application of social capital theory for analyzing the role of formal and informal teacher interactions in helping teachers enact changes to instruction associated with ambitious school reforms. Social capital theory posits that valued resources and expertise are embedded within social networks and that it is through social ties that one gains access to and can make use of resources to effect change. The network perspective directs researchers to focus simultaneously on the overall social structure of a school and on the expertise and resources exchanged through interactions among teachers that*

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take place in meetings, staff rooms, hallways, and classrooms.
Setting: *Our illustrations are contrasting cases of teacher communities in two elementary schools in California. In both school communities, the principals were committed to the idea of fostering greater interaction among colleagues as a strategy to improve literacy instruction. Both schools had similar levels of resources to support their goals through external funding from the state, but the schools had had different levels of success in implementing their reforms at the time of the study.*
Research Design: *We used an explanatory case study methodology that relied on social network, survey, and interview methods as sources of evidence for several alternative hypotheses relating to how the distribution of resources and expertise may have contributed to these schools' different levels of success in implementing their reforms.*
Conclusions/Recommendations: *The comparative case analysis of the two schools provided evidence that analyzing the internal structure of the school community was necessary to help account for the distribution of access to resources and expertise in these two schools. Moreover, there was some evidence from survey and network data that the distribution of valued resources and expertise was related to the level of change observed in each school.*

INTRODUCTION

As scholarship on teachers' professional interactions in schools has matured, researchers have suggested several theoretical lenses for examining how these interactions can contribute to teacher learning and to the diffusion of innovations in schools. A strong tradition of research considers how teachers' interactions simultaneously influence and are influenced by prevailing norms of autonomy, individualism, or collective responsibility (Westheimer, 1998). The idea that teachers in a school constitute a "community of practice" (Lave & Wenger, 1991) is another lens for studying teacher interactions, and it draws attention to teachers' roles in co-constructing ways of thinking, speaking, and valuing instruction in joint endeavors (Grossman, Wineburg, & Woolworth, 2001; Little, 2003). More recently, scholars have advocated looking at teacher collaboration as a form of distributed leadership within school, mediated by artifacts and routines for discussing and sharing problems of practice (Halverson, 2003; Spillane, 2006; Spillane, Halverson, & Diamond, 2001).

In this article, we argue that a *social network analysis* of teacher community, grounded in sociological conceptions of social capital, offers a framework for understanding the role of formal and informal teacher interactions in helping teachers enact changes to instruction associated

with ambitious school reforms. Social capital theory posits that valued resources and expertise are embedded within social networks and that it is through social ties that one gains access to and can make use of resources to effect change (Coleman, 1990; Lin, 2001; Portes, 1998; Woolcock, 1998). Thus, a network perspective on teachers' interactions draws attention not only to the social structure of the school but also to the expertise and resources exchanged through interactions among teachers that take place in meetings, staff rooms, hallways, and classrooms. It can also be used to analyze the efficacy of reform coaches for improving teachers' access to expertise and resources and for facilitating the change process. When coupled with interview and observational data, social network data provide information on how the social structure of the school supports or impedes the flow of expertise in a school and on how well situated particular reform leaders are to facilitate sharing of expertise and resources among colleagues in a school.

As evidence for these claims, we present contrasting cases of teacher communities in two elementary schools in California. In both school communities, the principals were committed to the idea of fostering greater interaction among colleagues as a strategy to improve literacy instruction. Both schools had similar levels of resources to support their goals through external funding from the state. Yet in one school, there was widespread commitment to reform goals, and the school made substantial progress toward increasing the achievement of its lowest achieving students. And in the other, even with more time allocated to meetings, there was no shared understanding of the reform goals, and teachers complained of a fragmented social network and limited access to valued resources. As we argue from these cases, a network perspective on teacher community offers a powerful lens for analyzing how each school's practices for facilitating the flow of expertise and resources across teachers and classrooms led to these different outcomes.

THEORETICAL BACKGROUND

LENSES FOR STUDYING TEACHERS' PROFESSIONAL INTERACTIONS

One of the most important perspectives on teacher interaction developed in recent years has been the *community of practice* perspective. The community of practice perspective draws attention to the ways in which teachers' interactions with one another, in which they engage with artifacts and representations of teaching, constitute a system of practice that can enable ongoing learning and development (Halverson, 2003; Little, 2003). Central to understanding teacher learning and development

within such a system is the idea that teachers are participants in the community, taking on particular roles and responsibilities within it and using available resources to reproduce, improve, or even transform practice (Lave & Wenger, 1991; Little, 2003; Wenger, 1998). The practices that teachers share allow for the formation of social ties through which expertise can flow, and the more that particular teachers share with respect to practice (e.g., a common grade level or similar philosophy of teaching), the more readily information and knowledge is likely to flow (Brown & Duguid, 2000; Wenger).

Scholars who advocate looking at teacher interaction through this lens are quick to point out that any group of teachers does not constitute a community of practice, much less one that is likely to result in improvements to instruction (Grossman, Wineburg, & Woolworth, 2000; Grossman et al., 2001). A fundamental assumption of work in this area is that to be successful, teachers' interactions should be focused on improving instructional practice (Darling-Hammond, Bransford, LePage, & Hammerness, 2005; Grossman et al., 2001). Further, part of any community of practice that learns and grows is active engagement with difference and conflict; for teachers, differences in instructional approaches and conflict over strategies need to be actively addressed by participants (Achinstein, 2002a; Grossman et al., 2000; Little, 2002; McLaughlin & Talbert, 2001). To study teacher communities, therefore, requires careful attention to local interactions and "micropolitics" (Achinstein, 2002b) and to specific representations of practice made by teachers (Little, 2003), and to how these contribute to constituting a system of practice.

Since the 1980s, researchers studying teacher collaboration have focused their attention on the structural sources of isolation of teachers from one another and cultural norms of autonomy and privacy that make it difficult for teachers to share and discuss aspects of their instruction (Little, 1982,1990; Westheimer, 1998). Researchers in this tradition have also documented how norms can help build relational trust among colleagues through their interactions and how, in turn, trust can function as a resource for school improvement (Bryk & Schneider, 2002). The relationship between a sense of collective efficacy and school achievement (Goddard, Hoy, & Woolfolk, 2000) and between collegiality and achievement (McLaughlin & Talbert, 2001) have also been examined. What these scholars have in common is an interest in how norms and beliefs held by teachers can support or hinder efforts to improve teaching and learning in schools. Their methods differ from those studying teacher communities of practice in that they tend to combine evidence from case studies and large-scale data sets to examine relationships between norms and outcomes of interest.

More recently, a new line of work has directed attention closely to the ways that teachers' interactions help to constitute a form of leadership within a school. This work, led primarily by Spillane and colleagues (Spillane, 2006; Spillane et al., 2001) and by Gronn (2002), has investigated how leadership practice is constituted in interactions among different school leaders, many of whom are teachers or teachers functioning as mentors to their colleagues. Their work has drawn attention in particular to how collaboration is organized, and their case studies of reforming schools in Chicago show that for teachers to benefit from their time together, they not only need access to good resources, but they also need access to resources that they can use for structuring how they use their time with one another (Curry, Gearhart, Kafka, & Little, 2003; Halverson, 2003). In schools where teachers had formats for interacting with colleagues around problems of practice in which they could raise questions about practices, meetings were more successful than in schools where meetings focused on administrative issues or where formats did not permit deep discussions of practice.

Despite the strengths of each of these approaches for helping to explain both the dynamics and consequences of efforts to build teacher community, each approach has important limitations. The qualitative methods favored by scholars analyzing teachers' interactions from a community of practice perspective necessarily must focus their efforts on understanding a subset of collegial interactions in a school, rather than on the full network of social ties that help constitute the community. These studies tend to focus much more on learning that takes place as part of formal meetings rather than on discussions that take place in hallways, lunchrooms, or staff workrooms. They also tend to focus either on individual participants or on community development as a whole and do not focus on interactions that take place within cliques or subgroups in a school. Researchers studying norms in their analyses tend to treat such norms as aspects of a single school culture; they do not typically attend to how perceptions might differ for individuals or for subgroups of teachers in a school (Bidwell & Yasumoto, 1997; Coburn & Russell, 2006; Yasumoto, Uekawa, & Bidwell, 2001). Finally, researchers studying the distribution of leadership practices across people, tools, and situations do tend to acknowledge the network structure of interactions, but their work tends not to consider the role of informal subgroups of teachers in mediating access to valuable resources and expertise (Penuel, Frank, & Krause, 2007).

A SOCIAL NETWORK APPROACH TO ANALYZING STUDYING TEACHERS' PROFESSIONAL INTERACTIONS AS SOCIAL CAPITAL

Our own research focuses on how professional interactions facilitate the exchange of resources and expertise that teachers need to enact curricular reforms. The lens we use for studying the enactment of reforms derives from the theory of social capital as developed in sociology and political science (Coleman, 1988, 1990; Lin, 2001; Portes, 1998; Putnam, 1993; Woolcock, 1998). The theory defines social capital as the resources and expertise that individuals can access through their ties with others that facilitate certain actions. Social capital has a network structure (Burt, 2000; Lin); that is, resources and expertise are embedded within particular positions in a social network and not freely available to anyone in a particular system. Rather, it is through one's ties to others that one gains access to particular expertise and resources by relying on norms of helpfulness and obligation to others that arise among individuals who interact frequently with one another (Portes & Sensenbrenner, 1993).

Below, we articulate four main benefits of studying the network structure of social capital among the faculty in a school. Two benefits are aimed at enhancing descriptions of teacher community. We argue that studying faculty networks can help produce a better understanding of the internal structure of school community. Second, network analyses can produce measures that help explain changes in teachers' attitudes and behavior. More practically, network data can provide useful information to policy makers and school leaders about the success of initiatives designed to promote greater collaboration in schools. Network analyses can also help evaluate and improve initiatives aimed at enhancing instruction through the use of formal and informal coaches or reform leaders.

Analyzing the social network of professionals in a school can help scholars articulate the internal structure of a teacher community. Past research has found that teachers' ties are often organized into an informal structure composed of subgroups (Frank, 1996; Frank & Zhao, 2005). These ties reflect feelings of closeness of colleagues to one another, feelings that can signify professional bonding and/or friendship, and in schools, these often overlap (Spillane, 2007). Teachers tend to be professionally close and interact with just a few colleagues in the school, and teachers rely on those with whom they may share common beliefs about teaching (Bidwell & Yasumoto, 1997; Yasumoto et al., 2001). A mathematical algorithm identifies subgroups in which interactions are concentrated (Frank, 1995). This algorithm yields a picture of the

school's social network based on actual ties of individuals to one another, as reported by those individuals. A social network analysis can be an analysis of different kinds of ties (e.g., professional, friendship), and an analysis of social capital can consider different types of resources and expertise that are accessed through those ties (e.g., curriculum, teaching strategies, technical skills).

A second reason that it is important to study how subgroups are composed and linked to the network as a whole is that subgroup members are important sources of influence on teachers' attitudes and behaviors. Members of one's immediate subgroup tend to have a stronger influence on others' behavior and beliefs than do other members of a social network, because the interaction is most frequent within those subgroups (Festinger, Schachter, & Bach, 1950; Homans, 1950). Subgroups also mediate individuals' relationship with the broader organization; they are settings in which subcultures with different norms and views of the organization as a whole can emerge and be reinforced through interaction (Nee & Ingram, 1998). Our research has shown that the level of reform implementation in a teacher's own subgroup influences the degree to which he or she changes his or her own practice, as does his or her access to expertise and resources from outside one's immediate subgroup and from outside the school (Penuel, Frank, & Krause, 2006). In addition, we have found that individuals' perceptions of the sense of collective responsibility in the school as a whole is influenced by subgroup behaviors (Penuel, Frank, & Riel, 2007).

Comparing the subgroup structure to the formal school organization of the school can be used to assess the success of initiatives designed to promote collaboration in a school. Instructional leaders often set up teams of teachers to work together toward reform goals, and sometimes those teams are facilitated by coaches or mentors from inside or outside the school (Camburn, Rowan, & Taylor, 2003). The intent of such groups is to spur greater interaction among colleagues on professional matters. Comparing actual patterns of interaction with team membership can yield data on how successful those efforts are at promoting the development of more enduring professional ties in a school. To the extent that such ties are promoted through formal collaboration, the need to rely on formal inducements or mechanisms to foster exchange of resources and expertise may be reduced somewhat as teachers share willingly and freely with their colleagues. This is one of the chief advantages of increased social capital in an organization: the reduction of so-called exchange costs associated with bureaucratic efforts to control the flow of resources through mandates, rules, and formal policies (Lin, 2001). Conversely, when initiatives to promote formal collaboration fail, professional ties

may be diminished in number and quality, making it even harder to facilitate the flow of expertise in a school.

Finally, a social network analysis can show which individuals play critical roles in transferring expertise that exists in one subgroup to another, thus helping school leaders identify people who are critical to change efforts. Many schools today have instructional coaches or facilitators of reforms whose formal role is to facilitate the flow of expertise and resources in a school (Neufeld & Roper, 2003). Network analyses can provide useful data to leaders and policy makers on the extent to which teachers in these roles are in fact serving as "bridges" within their schools, helping transfer resources from one teacher to another and from one subgroup to another (Burt, 1992). Analyses of the role that National Board Certified teachers play in helping colleagues in their school illustrate this approach (Frank et al., 2006). Network analyses can also help identify people playing "informal" leadership roles in schools, people to whom leaders could turn to help advance particular reform goals. An example of this use of network analysis comes from studies of distributed leadership, which use network analyses derived from teachers' reports of who they turn to for advice to identify key leaders who play a bridging role between groups that share ideas about teaching in particular subject matter (Spillane et al., 2006).

A SOCIAL CAPITAL ANALYSIS OF TWO SCHOOLS' NETWORKS AND CURRICULAR REFORMS

In this article, we use these three foci for a social network analysis of teachers' social capital—mapping the internal social structure of the school, identifying the positions of mentors and coaches, and analyzing the value of teachers' interactions in terms of the resources and expertise they exchange—to illustrate the power of a network approach to analyzing teachers' social capital. Our aim is to show that social network methods and qualitative methods used often by those studying teacher communities are complementary and that social network analysis provides a valuable and consequential picture of the broader social context needed to make sense of more in-depth qualitative analysis (Frank, 1998). Therefore, in each section of our results, we shift back and forth between network and qualitative data, showing how one illuminates and helps interpret the other.

Our analysis focuses on two schools with many similar features and challenges enacting a similar reform in response to identification as a low-performing school. We selected these two schools from a sample of 23 schools in a National Science Foundation-funded study examining the

relationship between schools' social capital and implementation of schoolwide reform efforts. We selected these two schools because they served similar groups of students, struggled with similar problems in reaching students, and engaged with similar curricular materials, and yet changes required of teachers were widely implemented in one school's reform effort but not in the other's.

The two schools, which we will call Glade and Crosswinds, have been participants in California's Immediate Intervention/Underperforming Schools Program (II/USP) program. This program began in 1999 as a provision of California's Public Schools Accountability Act. As part of this program, underperforming schools could apply for grants to support school change efforts, selecting either a nationally recognized comprehensive school reform model or developing and submitting a locally defined plan for reform. Both schools chose to adopt their own designs for implementing II/USP initiatives, and both were focused on literacy. As part of their efforts, they have adopted Open Court as either one of many curriculum materials available to teachers or as the primary literacy program. In addition, both hired intervention teachers with the II/USP funds as a part of their plan for improving students' reading and writing abilities, especially for English language learners.

Although both schools were designated II/USP schools at the same time, they were in different stages of implementation of their reforms; since then, they have met with dramatically different levels of success. Prior to the II/USP designation, and in response to changing bilingual policies at the state level, Crosswinds had been engaged in retraining bilingual teachers to teach in English-only classrooms. They were able to use the II/USP to extend a reform effort that had been in place for about 3 years. Glade Elementary began a process of change in 2002 as direct response to their identification as a low-performing school. Nonetheless, at the time that they received funding, both schools had students who suffered from low achievement, especially in reading and language arts, and the schools had been under significant pressure from the state to improve their performance. By the time we began observing the school in 2003 and 2004, Crosswinds had accomplished a dramatic increase in students' performance on state test scores, from a low-performing school to a high-performing school (18% growth on California's Academic Performance Index[1] in the first 3 years of the initiative, 30% growth between 1999 and 2004). Glade had not yet solved its problems that contribute to low performance. In the first 3 years of the initiative, Glade's Academic Performance Index had increased just 3%.

Using an explanatory case study methodology (Yin, 2003) that relied on social network, survey, and interview methods as sources of evidence,

we explored several alternative hypotheses relating to how the distribution of resources and expertise may have contributed to these schools' different levels of success in implementing their reforms:

> H_1: The schools faced fundamentally different challenges in meeting the needs of their students and thus are not comparable in terms of their success.
> H_2: Differences in the amount of time allocated for group and grade-level meetings and the emphasis placed on teachers to collaborate with one another led to less frequent interaction on matters of instructional practice.
> H_3: Differences in the school leaders' beliefs about the sources of expertise needed for school change led to different approaches for responding to outside pressure and to the development of different school norms.
> H_4: Differences in the internal social structures of the two schools affected the way that expertise and resources flow freely within and across subgroups, affecting the way that the reforms were implemented by teachers.
> H_5: The choice and roles of mentors and coaches shaped how information and expertise traveled through the schools, shaping instructional practices.
> H_6: The two schools differed with respect to teachers' access to valued instructional resources to support their efforts to enact curricular reforms.

METHODOLOGY

CHARACTERISTICS OF THE SCHOOLS

These schools were selected in part because of the similarity of their size and demographics of their student body. The Glade School is a public K–8 school in Northern California. Just below 75% of Glade's 726 students are Hispanic, and another 15% are African American. Roughly 40% of students are English language learners, and 13% are eligible for free or reduced-price lunch. The second school, Crosswinds Elementary School, is a public K–6 school in Southern California. Seventy-three percent of the school's 663 students in the school are Hispanic, and less than 1% are African American. Roughly two thirds of the students in the school are English language learners, and 73% are eligible for free or reduced-price lunch.

Crosswinds Elementary School is located in a larger, more advantaged

community than Glade. Crosswinds is the only school with a large number of Hispanic students in a middle-class suburban community of roughly 75,000, in which approximately 1% of the population are African American, and 11% are Hispanic. Glade, by contrast, is located in a working-class community of 30,000 people, the majority of whom (59%) are Hispanic. Another 23% of the community's residents are African American.

TEACHER CHARACTERISTICS

We obtained faculty rosters from the two schools in the study for teachers to use in identifying colleagues who were part of their collegial networks. We focused on those faculty members with teaching responsibilities because our measures of expertise focused on aspects of teaching practice. Our faculty roster at Glade included 43 faculty members with teaching responsibilities. Of these, 34 (79.1%) completed our questionnaires, and 6 participated in interviews with our research team members.

Table 1. Characteristics of Faculty Respondents to Questionnaire

	Glade	Crosswinds
Gender		
Male	7	6
Female	27	27
Race/Ethnicity		
White	10	17
African American	9	0
Hispanic/Latino	4	12
Asian	7	1
Other/unknown	4	3
Teaching Experience		
Overall years teaching	*M* = 14.4	*M* = 15.6
	SD = 12.5	*SD* = 8.1
Years at school	*M* = 6.3	M = 8.1
	SD = 7.2	*SD* = 4.5
Teaching Assignment		
K	2	3
1	2	3
2	3	4
3	4	6
4	2	3
5	2	3
6	2	3
7	4	—
8	4	—
Other or combined roles	9	8

There were 9 faculty members on the roster who did not respond to our survey: the inclusion specialist, the computer teacher, and 7 regular classroom teachers. The missing classroom teacher questionnaires were from 2 first-grade teachers, 1 second-grade teacher, 3 fifth-grade teachers, and a single eighth-grade teacher.

Our faculty roster for Crosswinds included 39 faculty members with teaching responsibilities, the same number as Glade. Of these, 33 (84.6%) completed our questionnaires, and 6 participated in interviews. Of the 6 faculty members on the roster who did not respond to our survey, 3 were arts teachers and 3 were pullout program staff members. Table 1 shows the basic characteristics of respondents to our questionnaire by school.

SOURCES OF DATA

Interview Protocols

We developed separate interview protocols for school leaders and for teachers in each of the 3 years of our study. School leaders included the principal, assistant principal, and instructional coaches. In 2003–2004, the school leader and teacher interview protocols included questions about the nature of the schoolwide initiative, the typical implementation process for new initiatives at the school, patterns of communication at the school, and perceptions about the school's social network. Interview protocols in 2004–2005 focused on collegial interactions in the school in general, teachers' perceptions of the schoolwide initiative and its successes and challenges, and the nature of interactions around the initiative. The interviews in the third year (fall 2005) focused on the utility of social network analysis as data to support school reform.

Faculty Questionnaire

A questionnaire administered to all staff with responsibilities for classroom teaching in fall 2004 provided us with data we used to characterize the social ties among faculty at the school, their perceptions of norms governing collegial interaction at the school, and reports about how much the reform influenced their teaching practice.

Collegial ties. We asked teachers a set of questions related to their informal social networks. Teachers were asked to identify the people they considered to be their closest professional colleagues using a numbered roster provided them with the names of all the staff (including school leaders) in their school. For each colleague selected, the respondents

were asked to indicate the frequency of interaction, with options of daily, weekly, monthly, or once or twice a year. These responses were used to identify cohesive subgroups and then embed subgroup boundaries in a "crystallized" sociogram (Frank & Yasumoto, 1998; Frank & Zhao, 2005). These responses also form the basis for two measures we report on here in our analyses: (1) *weighted in-degree*, defined as the number of people who nominate an individual as a close colleague multiplied by frequency of interaction, and (2) *weighted out-degree*, defined as the number of people a person nominates as a close colleague, multiplied by frequency of interaction.

Access to material, human, and social resources and expertise. In addition to relying on interview data to help us characterize the value of expertise accessed through collegial ties, we used four questions from the faculty questionnaire about teachers' perception of the value of three different kinds of resources: (1) materials needed to implement the initiative; (2) time to collaborate with colleagues to plan for implementation; and (3) access to experts inside and outside the school to assist with implementation.

Participation in committees or teams where reform is discussed. A common problem documented in research on teacher communities is that teachers have too little time to engage in conversations about practice from different perspectives (Little, 2003). Therefore, we sought to measure this possible explanation for the two reforms' success by analyzing the frequency with which teachers engaged in discussions about the reform in different formal settings. We asked teachers to identify how often they participated in eight different committees or teams in which the reform is discussed (0 = *not at all*; 1 = < *1 time per month*; 3 = *2–3 times per month*; 4 = at least weekly). We calculated a weighted sum from faculty members' responses to all eight types of meetings to measure their level of participation in formally structured leadership practices related to the reform.

Norms for collegial interaction. We also measured faculty members' perceptions of norms governing collegial interaction in the school using two different scales. One scale included four items from the Teacher-Teacher trust scale reported in Bryk and Schneider (2002) to measure perceptions of trust among faculty at each school. This scale asked teachers to indicate the extent to which they felt trust, respect, and mutual regard for fellow faculty members at the school. The items used a 4-point scale from *strongly disagree* to *strongly agree,* and the scale in our study had a reliability of · = .86, similar to the reliability found in Bryk and Schneider's study (· = 0.82). We also used a five-item measure of collective responsibility, also adapted from Bryk and Schneider. Collective responsibility is a measure of teachers' perception that all staff have a

shared commitment to the goals of the school and to fostering student learning. This measure asked teachers to indicate the proportion of teachers in the school who they believed felt a sense of responsibility for different aspects of school functioning on a 5-point scale. The scale had a reliability of · = .89 in our initial study, similar to the reliability found in Bryk and Schneider's study (· = 0.92).

Background variables. We collected data on several faculty background variables, including the gender and ethnicity of each faculty member, the number of years each had spent teaching, and the number of years that each had been at his or her school.

METHODS OF ANALYSIS

The two analytic methods we employed in these case studies were (1) social network analysis, which we used to analyze the social structure of the schools, and (2) grounded theory, for revealing specific themes from interviews with teachers and school leaders related to the topics of collaboration, resources, and perceptions of reform activities at schools. Analytically, we used the two methods to be mutually informing; that is, we used social network data to provide a social context for interpreting case study data, and we used the case study data to help understand and interpret the social network data and explicate how and why individual access to expertise and resources varied from school to school (see Frank, 1998, for an extended discussion of the complementarity of these two methods).

Using algorithms developed by Frank (1995, 1996), we applied stochastic criteria to determine permeable, nonoverlapping subgroup boundaries. Each individual teacher was assigned to one subgroup on the basis of how likely it is that members of subgroups will interact with one another, based on data that each teacher provides us from a questionnaire. In addition, we calculated a measure, ι_1, for each school that indicates the salience of subgroups for interactions. Frank's algorithm maximizes ι_1 and represents the increase in the probability that two actors interact if they are members of the same group. The value of ι_1 can and does vary by school, allowing researchers to compare different networks with respect to the frequency of within- and across-group interactions.

Once we identified subgroups and their members, we developed hypotheses about how to interpret the depicted relationships by examining differences among subgroups with respect to teacher characteristics and perceptions. Characteristics that we examined were teacher assignment (either grade or subject), years of teaching experience, years at the school, gender, and race/ethnicity. Even with small numbers of

participants, statistical tests revealed significant differences among subgroups on characteristics, as we describe next in our case studies. Teacher perceptions we analyzed included beliefs about the level of trust in the school, collegiality, and sense of collective responsibility among the faculty. Typically, these kinds of measures are examined in the aggregate at the school level (see, e.g., Bryk & Schneider, 2002; Hoy, Tarter, & Witkoskie, 1992), but we have examined how these characteristics vary by subgroup.

Simultaneously, a group of qualitative researchers familiar with the schools in the study began a process of iterative coding of the data, drawing on a modified grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1990) approach. As in grounded theory, we worked inductively from our data to develop a set of codes, using only a broad set of initial research questions as a guide. These questions pertained to when and how teachers sought expertise from colleagues and coaches in the school, their perceptions of the adequacy of the available resources and expertise for implementing the reform, and their attitudes toward the reform itself. Once an initial set of themes was identified for coding and a coding guide was developed for identifying those themes, two coders worked independently to identify answers to interview questions that provided evidence for a particular code; reliability checks were performed on roughly 10% of the data set to ensure agreement of 70% or higher for codes. Subsequently, the first two authors of the present article organized themes and codes by categories that would allow us to examine alignment with sociometric data. We grouped themes relating to the overall density of interactions, school-level resources, the social structure of the school, and individual access to resources and expertise.

We then drew on this coded qualitative data to help us interpret the sociometric data. This particular step is critical to interpreting the nature of the social capital of the school, especially the nature of exchanges that take place at the school with respect to resources. For example, we compared what we heard in interviews about perception of resources with data on school norms and levels of expertise as indicated by implementation level to help us understand how similar perceptions of access to resources were in the school. Further, we used the qualitative data to gain a richer insight into the context—to learn why, for example, teachers might tend to cluster by grade level or by experience level in the school. Interviews thus provided us with rich data on teachers' own beliefs about the reasons for cohesion, fragmentation, and conflict within the school community.

RESULTS

The results of our analysis of surveys, interviews, and network data are presented next, organized by each of our five research hypotheses.

SIMILARITIES BETWEEN THE REFORM PLANS AT GLADE AND CROSSWINDS

Several similarities in reform plans are important to point out because they make the comparison between these two schools instructive. The schools have the same focus, improving achievement of English language learners. In addition, the schools both have sought to increase teachers' access to expertise and resources for addressing the needs of English language learners by hiring coaches and freeing up time for teachers to collaborate with one another.

First, both schools have a similar focus: improving the reading achievement of low-income English language learners at the school. English language learners in both schools are primarily students from families of Central American origin who have recently immigrated to the United States. Because the schools serve primarily low-income students, furthermore, they face similar institutional pressures to improve the achievement of their English language learners from the federal No Child Left Behind Act, which requires students in all significant subgroups in a school to show progress toward 100% proficiency in reading by 2014.

In addition, both schools have sought to increase teachers' access to expertise in literacy by fostering greater interaction among faculty members within the school. Both principals used II/USP funds to hire coaches whose job it was to increase the flow of expertise and resources through

Table 2. Teacher Reports of Attendance at Meetings Where They Discuss Reform Activities

	Glade		Crosswinds		
	M	*SD*	*M*	*SD*	*t (df)*
Same grade-level teams	3.21	1.32	2.41	1.55	2.28* (65)
Multiple grade-level teams	1.97	1.36	1.32	0.98	2.24* (65)
Department/subject teams	1.48	0.91	1.79	1.24	1.53 (65)
School governance meetings	1.03	0.79	1.26	1.09	0.82 (65)
Whole faculty meetings	2.55	0.90	2.32	0.88	1.02 (65)
Special committees	0.84	1.37	0.97	1.14	-0.41 (64)
Technology meetings	0.45	0.75	0.47	0.66	-0.09 (65)

0 = *not at all*; 1 = *less than once per month*; 2 = *every month*; 3= *every 2–3 weeks*; 4 = *at least weekly.*

* $p < .05$.

the staff to enable their respective literacy reforms to succeed. At both schools, the reform changes created abundant opportunities for teachers to collaborate with one another and discuss their reform activities, as evidenced by data from our surveys. As Table 2 shows, teachers in both schools discussed their school's reform activities regularly in grade-level meetings, in multigrade teams, and in whole-faculty meetings. Glade teachers reported significantly more same-grade and multigrade team meetings then did the teachers at Crosswinds, however.

Consistent with this pattern in the data, we found that the overall density of interaction was similar across the two schools (see Table 3). The weighted density of helping interactions—that is, reported frequency interactions with colleagues that involved teachers collaborating with or receiving help related to the initiative—is similar for Glade and Crosswinds. These interactions represent roughly a third of all professional interactions, as represented by the weighted density of collegial interactions. Further, the values of ι ?that is, the odds of engaging in interactions with members of one's own subgroup as opposed to people outside one's subgroup—for both schools are similar, indicating that at both schools, teachers are roughly equally likely to obtain help in implementing the initiative from someone outside their immediate subgroup.

Table 3. Probability of Teachers' Interacting Across Subgroups

Variable	Glade	Crosswinds
Collegial Interactions		
Weighted density of interactions	0.17	0.15
Total θ	0.89	0.98
Initiative-Related Help		
Weighted density of interactions	0.06	0.06
Total θ	0.83	0.97

The similarities in these two schools' overall reform designs, as well as evidence from our survey data on the two schools, led us to rule out the first hypothesis for why one school's reform initiative has taken hold and the other has not. Both schools faced similar challenges with respect to the needs of the population of students served. Similarly, neither school was hampered by limited time allocated for collaboration among faculty at the schools, an obstacle often reported in studies of reform (Elmore, 1996; Little, 2003). In fact, Glade teachers spent *more time* in meetings in which their reform was discussed overall than the teachers at Crosswinds did—a finding that directly challenges our second hypothesis that increased time spent in collaborative settings accounts for the different outcomes. Finally, both schools had a high level of internal accountability for results, reinforced by external pressure to perform mandated by

No Child Left Behind. So it is not likely that either the overall level of informal interaction or formal participation in meetings in the school in which the initiative is discussed accounted for the different perceptions of reform success across these two schools. These findings provide limited evidence to support either of our first two hypotheses.

SCHOOL LEADERS' BELIEFS AND PRACTICES

One of the striking differences between Glade and Crosswinds was in the level of trust, respect, and mutual regard that developed among faculty. The measure of relational trust we used in our study asked teachers about their beliefs in others' ability to fulfill their responsibilities and go the extra mile if needed, their faith that others will keep their word, and the extent to which teachers respected one another's dignity and ideas. On this measure, Glade faculty's reported level of trust ($M = 2.68$, $SD = 1.32$) was significantly lower ($p < .001$) than the level at Crosswinds ($M = 3.45$, $SD = 0.63$). Furthermore, there was greater variability in the level of perceived trust at Glade than at Crosswinds ($F = 10.65$, $p < .01$), with significant variability across subgroups.

In part, leadership beliefs and practice help to explain this pattern of differences, especially with respect to leaders' beliefs about teachers in their school and their ability to contribute to school change. At Glade, the principal expressed a strong belief that outside expertise and resources were necessary to improve her school. Besides the II/USP initiative, the principal proudly mentioned five major initiatives focused on technology, reading, mathematics, science, and special education that were all under way in her school in addition to the II/USP initiative. She noted that there were several groups of experts associated with these initiatives—including educational specialists, social services case managers, and graduate student interns—who visited the school daily. When hiring for the II/USP positions made possible through the grant, she only looked outside the school for candidates, using the Web as a resource for posting the position.

For the principal, the key component of each initiative in the school was the expert-developed educational materials associated with each. When asked what she would do if teachers were granted an extra 5 hours of work per week, she said that her focus would be on researching and obtaining new "supplies, materials, probably the latest information in regard to all educational realms." These materials were things she thought of as needing to be brought in, rather than developed, and she expected that her teachers would welcome these resources from outside the school:

> I mean, anything I ask my teachers or anything we bring in, they're just excited to learn, and the only time that we feel some type of concern, and it's really not resistance, it's just finding the time in the day and how is it going to really work, the logistics.

There is some evidence that teachers shared the principal's high regard for educational materials associated with different initiatives, including the II/USP initiative. When we asked one teacher the same question that we asked the principal about what she would do with extra time in her work week, this teacher said that she would spend time reviewing the curricular materials from Open Court on her own:

> I think I would deal more with Open Court and mathematics because a lot of activities in Open Court [are] in writing, grammar, comprehension and we don't have enough time to cover—go to the writing part ready, because spelling, spelling per se takes time and I notice that some of my third-grade students are really, really very poor in spelling.

Another teacher commented that she too would prefer to spend more time with materials, although she commented that her hope was to develop some supplementary "hands-on" materials to go with the Open Court materials. She did not object to those materials but said, "[I wanted] more time to go through all the material that's in my curriculum."

Despite interviewed teachers' general endorsement of the additional curricular resources made available through the II/USP initiative, one unintended consequence of bringing in so many resources from the outside was increased accountability to outside organizations providing those resources. There were extra meetings required of teachers to meet monitoring and evaluation requirements of grants, and the focus of these meetings tended to be on matters of accountability, not instruction. As the principal described meetings about one social services initiative in the school, the focus was, "Well, have you gotten your observation in? Your request times, have you those gotten in?" A teacher, commenting on the variety of initiatives at the school, noted that "each year there are more and more forms to fill out." For these additional responsibilities, no time or resources were specifically dedicated to completing forms, a fact that several teachers and the principal acknowledged. The result was that although teachers felt grateful for the outside help, time had become a scarce resource, and the time that teachers did spend interacting with one another was focused on meeting accountability requirements rather

than on the substance of teaching.

Leadership at Crosswinds was enacted in entirely different ways from Glade and was reflected in the interactions that took place within the school. Crosswinds's principal placed a premium on collegial interaction as the means to promoting instructional change. When asked about what she would have teachers do with an extra 5 hours a week of noninstructional time, she said, "I would have them working in collaboration on everything from assessment to standards to curriculum planning, looking at research materials together. Just improving their professional practices."

As at Glade, the principal at Crosswinds reports that teachers are willing to "try just about anything" but that it is teachers and the principal who bring new ideas to the school and discuss them. The real resource, she says, is the sense of camaraderie among faculty members and the fact that teachers are "working hard" for students: "Certainly a lot of them have previous training and experience that they're willing to share. They're laughing and enjoying each other and working hard for kids. So I would say that's a resource. Just their tenacity is a resource."

At Crosswinds, where there is talk about resources, the talk tends to take place among faculty in the school about how to adapt these resources to meet the needs of their students. One teacher described the talk in her regular meetings this way:

We have found in the sixth grade, particularly this year, sitting down for an hour, even more than one day a week, because we have the usual Thursday meetings, other days of the week we have a new language arts adoption this year, so plowing through the new curriculum and responding to the student response. We're giving them materials; what is their response to these new materials? What kind of modifications do we need to make in the program? What components do we want to keep in place as the program core? What are we going to determine for future uses, supplemental or auxiliary type stuff? So we've spent a lot of time doing that this year, collectively, so as a grade level group.

It is important to note that at the outset of the initiative, this sort of exchange was not evident throughout the school. Instead, the positive school culture was partly the result of conscious decisions on the part of the principal at the beginning of their reform process. In 1999, the school was under pressure from the district to make changes and improvements, and the district wanted to impose a particular model and curriculum on the school. The principal's response was to "circle the wagons" and protect the school from district interference. She set out to allocate time of one of her expert teachers to serve as a coach and to build a reform model that drew on internal expertise. These sequential

actions of resisting district interference and trying to facilitate the spread of expertise within her school created the ideal conditions for the development of a close-knit professional community. At least initially, the community coalesced around the idea of defending against a common threat to their autonomy, the district.

The school experienced small and early successes that were important to the development of community as well. The school implemented regular benchmark assessments, the results of which were posted in a faculty room where teachers could see which students needed the most help. Instead of holding individual teachers accountable for improving individual students' results, however, low-performing students became the collective responsibility of grade-level teams, and teams were given the full support and direction of the coaches, principal, and other intervention specialists. As one of the II/USP coaches said, the early efforts at developing regular assessments and looking at data of students who were underperforming paid off, and student achievement began to improve. As a result, teachers were both willing to put in continued effort on their own, and they encouraged other staff to do the same. As she put it,

> Once they got the results and they knew how to interpret the data and use the data, every teacher in their own way said it was worth the hard work. It still continues to the point now where some of the primary teachers are telling the upper grade teachers who are starting to complain, wait; hang in there, you'll be glad. By the time you finish the year, you will be so glad you did this.

Further, with early successes, the principal was able to maintain her strategy of buffering the school against district pressure to respond to new mandates:

> But I think when push came to shove, I've pretty much had to say, "Let me prove it. And if our test scores go down then I will do what you tell me. But if our test scores go up, let me keep doing what we're doing. And our test scores have never gone down, so hands off."

The different beliefs and actions of these two principals likely contributed strongly to the differences in overall levels of perceived trust among faculty members at the two schools. At Glade, the principal modeled respect for materials but paid less attention to developing the internal expertise of colleagues. She promoted interaction but primarily

focused on compliance to external grant requirements, and at the end of the day, individual teachers were accountable for meeting those requirements, perhaps making teachers feel as though they were more individually at risk if they failed. By contrast, the Crosswinds principal not only expressed a belief in the professionalism and expertise of her faculty her actions also showed that she was faithful to those beliefs and was herself trustworthy. The accountability system operated at the grade level rather than the classroom level. Individual risk was further reduced by modeling of strategies for working with low-performing students by the coaches. Collective responsibility minimized the risk of changing to a new practice.

THE INTERNAL SOCIAL STRUCTURES OF GLADE AND CROSSWINDS

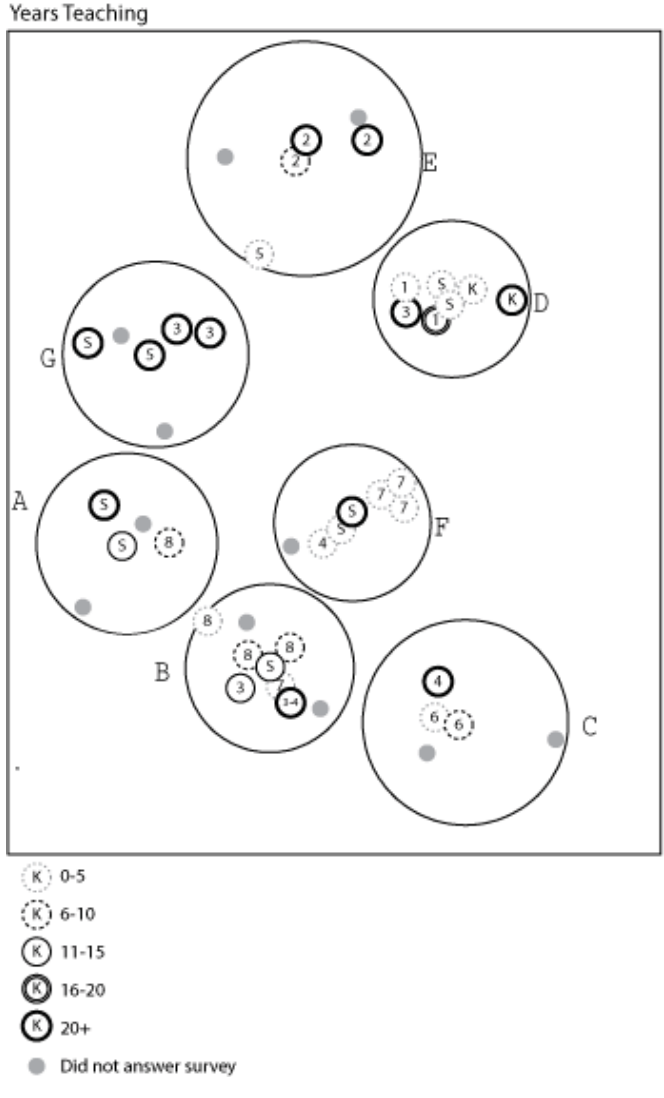
Although principal leadership does help to account for differences in the overall level of trust at the two schools, it cannot explain easily the differences in variability in levels that existed within subgroups at each school. A better explanation comes from a close examination of the structure of each school's social networks. The crystallized sociograms for the two schools, presented and discussed next, suggest that one school was more fragmented and the second was more cohesive. The informal structure of Glade does not map well onto the functional organization of meetings and groups in the school, whereas at Crosswinds, there appeared to be good alignment between the social network and social organization of the school.

One of the goals of the reform at Glade was to meet the learning and development needs of newer teachers by using coaches to free up time for novice teachers to collaborate with more veteran teachers to plan curricula. In most grade levels, there was a mix of veteran teachers, who are more likely to be fully credentialed, and more novice teachers, who were more likely to be teaching with an emergency credential or with a waiver from the state. Therefore, in principle, grade-level meetings ought to have facilitated the transfer of expertise gained from many years in the classroom and formal preparation to novice teachers. In fact, our social network analysis revealed a schism between veteran and novice teachers. Figure 1 shows the crystallized sociogram for Glade, including the experience levels and grade levels of teachers in the school.

In the sociogram, each small circle represents a member of the faculty, and grade level taught is denoted by numbers inside the circles. Resource teachers and leaders are represented by gray dots. The larger circles represent subgroup boundaries, and the larger the circle, the less cohesive the group. Distances depicted in the sociogram between individuals and

subgroups represent "social distance" as indicated by the likelihood that individuals or subgroup members interact. The larger the distance, the less likely it is that two individuals, or the members of two subgroups, interact with one another.

Figure 1. Crystallized Sociogram of Glade



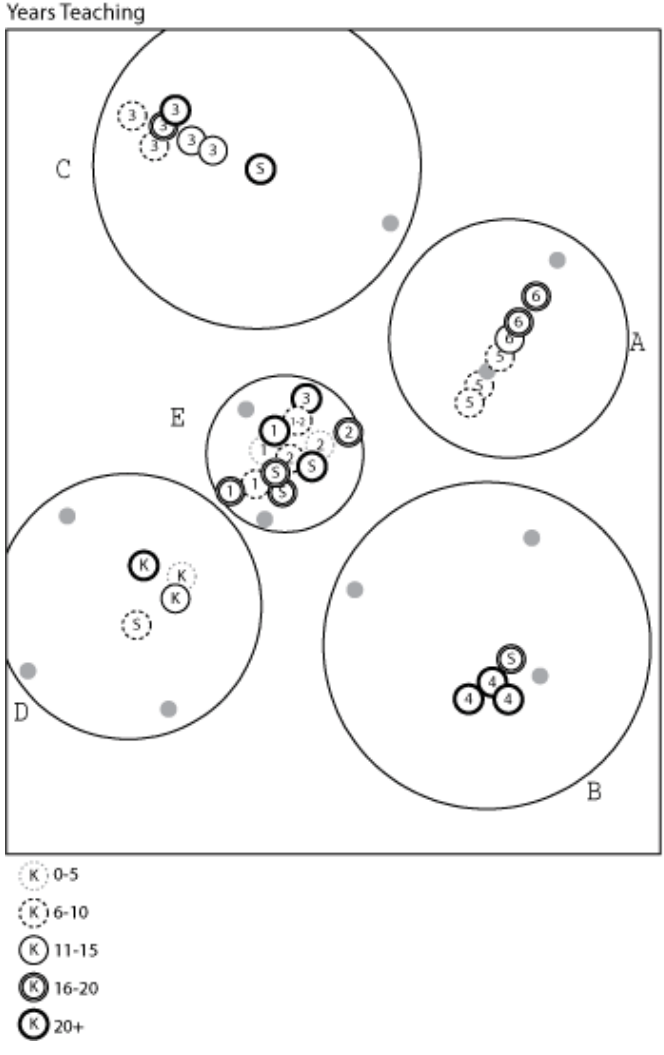
have over 20 years experience in the classroom. By contrast, Group F consisted almost entirely of teachers with only 2 years of experience in classroom teaching. Further, Group B had some teachers with more experience, but nearly all were in their first or second years of teaching at the school when we surveyed them. Group D included the primary II/USP teacher in the school, which consists of both veteran and novice teachers in the early grades. Thus, it was more likely, on the basis of this social structure, that early grades teachers (but not older grades teachers) will have access to the expertise and educational experiences of veteran teachers.

Our interviews with faculty members in the first year of our project confirmed that there was a perceived division between veterans and novices at the school. One newer teacher saw some of the veteran teachers in the school as uncommitted to helping others, remarking, "They don't even, that's another thing, they don't say anything, they just go about their own business and forget everybody else." Another teacher observed that there was too little opportunity for novice teachers to learn from veterans by observing teaching in veterans' classrooms, as was initially planned for the II/USP:

> We have a lot of new teachers who have never taught before, and so just things that they need as far as their teacher training. Some of them are getting some time because of II/USP to go and observe experienced teachers in their classrooms, but there isn't enough of that. It's all just little bits and snatches, to be able to have more time to do all that would be wonderful.

With respect to cohesion and access to expertise of colleagues, Crosswinds was strikingly different from Glade. The reform design puts the greatest emphasis on teachers' access to the literacy coaches in the school, especially in the lower grades. The social structure of the school, as revealed by social network analysis, showed a pattern in which subgroup boundaries were aligned more to grade-level assignments than to veteran status in the school (Figure 2). The largest subgroup, E, was composed of the primary teachers and included the literacy coaches. The smaller size of the subgroup reflects the higher frequency of the interactions, and their central location in the sociogram signals frequent interactions between the teachers in this subgroup and teachers from all the other subgroups. In general, there were far fewer novice teachers in the school, but it still would have been possible for veteran teachers to have interacted with one another more than they reported doing.

Figure 2. Crystallized Sociogram of Crosswinds With Background Data



Although Glade and Crosswinds teachers reported similar levels of interactions with colleagues, the ability of individuals to access relevant expertise of colleagues through the school's social network was more limited at Glade. At Glade, the social network was fractured, and those most in need of the expertise of their colleagues—novice teachers, those with emergency or temporary credentials—were far less likely to interact with

those with more experience or who were fully credentialed. By contrast, at Crosswinds, there were large, cohesive groups of teachers who interacted frequently, and at the social center of those groups was an expert in the reform with whom teachers could discuss implementation and ideas about teaching.

Data from teacher questionnaires about teachers' perception of the level of collective responsibility for student learning suggested that subgroup membership affected perceptions of teachers at Glade but not at Crosswinds. *F* tests analyzing perceptions by subgroup found significant differences across subgroups at Glade. Significantly, some of the least favorable impressions were among the members of Group D, which consisted of teachers who had the most significant responsibilities for implementing reforms. By contrast, there were no significant differences among Crosswinds subgroups on this measure, suggesting a more uniform (and positive) school culture focused on joint responsibility for student learning.

The routines and norms that teachers described as organizing collegial interaction differed from the typical and expected channels for communication, which helped to explain why these two schools were so different with respect to their internal social structure. At Glade, communication was expected to flow through hierarchical chains of command, with the principal being the primary source of information and grade-level leaders being disseminators of information to other members of grade-level teams. When teachers did get relevant information or learn new skills from outside professional development, they rarely shared it with others. By contrast, at Crosswinds, multiple teachers were engaged in actively seeking out outside expertise and then selected relevant ideas and materials to share with others in the school so that they could benefit from their individual experiences.

> Within Glade, teachers reported a clear delineation of channels of communication that flowed from the principal through grade levels. The principal did not encourage lateral communication across grades, which made grade levels "separate entities," according to one teacher. She noted, "But here in our school, although we are working—there's a grade-level chairman and we're working on a 6-week instructional planning, we don't know what the other levels are—what are their standards, where are they. We just know what our team is."

Another teacher said that she also had little knowledge about what takes place at the meetings of the grade level chairs with principals other

than what the ultimate decisions were that she would be asked to implement: "We don't know what transpires there, but when we are in a grade-level meeting, we're more concerned of our team. So probably when they go to the grade level, they might be discussing some more things which we don't know."

The isolation of grade levels from one another was paralleled by a feeling of isolation among teachers who felt that they had something to offer their colleagues. Veterans argued that meeting formats did not allow for veteran teachers to share what they knew with more novice teachers. As one veteran described it, workshops and meetings introduced topics that were "usually taught or instructed in a way where nobody knows anything. . . . And so we're starting from scratch, which is sort of insulting to those that have been around for a while." Furthermore, some veterans expressed concern about investing time in emergency-credential and new teachers, whom they perceived as lacking in a commitment to stay at the school for more than 1 or 2 years.

The primary source of information about literacy instruction, according to teachers, was biweekly professional development workshops offered by the district. However, both the principal and teachers at Glade complained that these district-planned sessions were disconnected from the context of classroom teaching. According to the principal, these workshops were not tied closely enough to site needs:

> Well, I'd like to also incorporate some other professional development. Right now, some of our professional development, because we're going through—our district is going through the change process—is district led and is more global for all of the schools, but being a specific site myself, we have site-specific needs, and so maybe some of the professional development would be tied to the site needs.

Teachers described the workshops as too abstract and as not offering enough "practical, hands-on things" or enough small-group interaction about ideas. Instead, these workshops offered "just a lot of information." When teachers did learn things from the workshops, what they learned rarely became a publicly available resource for their colleagues. In short, Glade provided little opportunity for teachers to extend what they know by making explicit what they learned through talk with colleagues or to check their understanding of messages they heard as part of their professional development.

At Crosswinds, there were far more opportunities for teachers to learn about what their colleagues were up to in the classroom than there were

at Glade. The principal and teachers themselves encouraged broad sharing and communication. Unlike at Glade, there were no clear "lines of authority" within Crosswinds that could not be crossed. Teachers routinely sought out resources from outside the school to help with their teaching, and they shared them with others. There was a pragmatic attitude toward using particular resources rather than one that emphasized approvals by "higher-ups" in the school. Consistent with that approach, the principal shared leadership responsibilities with her staff, including responsibilities for hiring. The result was a stable, committed staff with a high level of relational trust and strong sense of collective responsibility, which were reflected in our survey data.

THE POSITIONS AND ROLES OF LITERACY COACHES AT GLADE AND CROSSWINDS

The approach to hiring literacy coaches at the two schools and roles that they were expected to play also distinguished Glade from Crosswinds, and social network data helped illuminate the consequences of strategic decisions for the flow of expertise and resources in the two schools. Both formally and as revealed in the network analysis, the Glade II/USP teachers occupied a less central position with respect to the distribution of expertise in the school. Two early-career teachers served as knowledgeable "substitute teachers" to enable other teachers to comfortably leave their classrooms to collaborate with one another. By contrast, the Crosswinds literacy coaches were at the center of their subgroup and the social center of the school as a whole. At Crosswinds, the principal promoted a well-respected veteran teacher with deep content knowledge to serve as a literacy coach who would provide classroom assistance directly. She also hired a children's author part time to free up teachers by visiting classrooms as the "Story Queen." The literacy coach played a central role in monitoring the progress of the reform by overseeing teacher collection and use of data, and facilitating the transfer of successful instructional practices from one classroom to the next.

At Glade, the role of the II/USP teacher was to be a kind of substitute teacher. As one of the teachers described it, she was expected to "go into class and it's like a prep period for them, and they get this additional prep so they can meet as their team, so those are additional things they get." In practice, she expressed frustration at being pulled onto other projects of the principals, which took precedent over her role in facilitating teacher collaboration. This led her to feel less than effective in her role:

> I see more of my time going to those projects rather than being in the classroom. There are times when I had to cancel going to classroom because these other projects were more important. If you look at it that way, no, I don't feel I am effective. I feel someone else could do these projects and I could be more effective in the classroom.

The result was that few teachers felt they could count on her because she sometimes canceled her plans to cover their classroom. The result, she noted, was considerable frustration on the part of teachers in the school. The teachers see the II/USP teacher, she believes, as "doing nothing . . . just running around, running the office, or whatever." She summed up the perception of her role among her colleagues:

> I think coming in, again those feelings of burden, being more of a burden rather than a team player or part of the team, I think those feelings coming in, it was hard for me to just jump in and say hey, I'm a teacher, I want to do this with you. A lot of the teachers now, even like new teachers that I've spoken with, they say I love working with so and so and it helps me to this.

The role that the literacy coach at Crosswinds played was quite different from that of the II/USP teacher at Glade. At Crosswinds, the literacy coaches made frequent visits to teachers' classrooms, where they conducted observations and offered assistance as needed. One of the coaches said, "[I try to help] by going around and watching them, observing, going in the classrooms to see what's going on. Secondly, by talking to them and finding out just how much insight they have, how updated they are."

Teachers reported high respect for the literacy coaches and that observations of colleagues benefited them: "At this school, we have literacy specialists, so anytime the conversation is about that, of course they're going to be bringing up, oh, have you seen such and such is doing this in their class."

Social network data reveal the implications of the different roles that the II/USP teachers played at these schools in terms of their importance for facilitating the flow of resources and expertise in a school, a central function of coaches and mentors in most contemporary reform models. Although both II/USP teachers were part of subgroups that include teachers from grade levels with whom they are expected to work, the Glade subgroup was on the periphery of the school, and the Crosswinds subgroup was at the center of the school. Furthermore, the second-grade

teachers formed a separate, less cohesive group at Glade but were part of the same group at Crosswinds that was focused on early literacy. The II/USP teacher was expected to work with teachers at other grade levels as well but was not as well connected to them within the school.

Individual data on the coaches further revealed differences in their ties to other colleagues. The Crosswinds II/USP teacher was nominated frequently as a source of help by others, both from others within her subgroup and outside it. By contrast, the Glade II/USP teacher was nominated as providing help to others much less frequently, both within and outside her subgroup.

Table 4. Social Network Data for II/USP Teachers

	Glade II/USP Teacher	Crosswinds II/USP Teacher
Centrality (inverse radius)	1.07	61.92
Total Indegree*	831	1,504
Within subgroup indegree	530	978
Outside subgroup indegree	301	526

*Sum of colleagues nominated as "close" multiplied by frequency of interaction

THE PERCEIVED VALUE OF INTERACTIONS FOR MAKING CHANGES TO PRACTICE

Social network and attribute data from surveys, as well as interview data, can help us interpret how the content of interactions in the two schools may have contributed to the differential success of the two schools' reform efforts. As Table 5 shows, another important difference between the two schools in our study was individuals' ability to access valued resources to support implementation of their reforms. Despite having received similar levels of grant funding from the state for their initiatives, teachers at Glade were significantly less likely than teachers at Crosswinds to believe they had access to needed materials, opportunities to discuss the initiative with colleagues, or mentors and social support.

Table 5. Teachers' Ratings of Resources to Support Implementation

	Glade		Crosswinds		
	M	*SD*	*M*	*SD*	*t (df)*
Access to needed materials	2.85	0.91	3.42	0.85	2.46* (56)
Opportunities to discuss initiative with colleagues	2.48	0.92	3.10	0.80	2.61** (53)
Access to mentoring and support	2.85	0.91	3.40	0.81	2.41* (55)

1 = *strongly disagree*; 2 = *disagree*; 3 = *agree*; 4 = *strongly agree*.
* $p < .05$. ** $p < .01$.

Interestingly, perceptions of access to valued expertise were correlated with the network measure of in-degree—that is, the number of colleagues (weighted by interaction frequency) who indicate that an individual was a close colleague. Correlations between perception of adequate access to materials was significant, at $p = .08$, and for the mentoring item, at $p = .07$. One interpretation of this result is that when others listed a teacher as a colleague, they felt an obligation to him or her to share resources and expertise—hence the perception of those individuals that resources were more widely available.

The way that teachers engaged in instructional planning can partly explain these different ratings. At Glade, the principal developed an instructional planning template that she intended teachers to use during the time that she had freed teachers to work together to plan literacy instruction. According to the principal,

> We use instructional planning template in which we're trying to have goals and targets be met, and they discuss those. They should be discussing student work. I ask them to look and bring student work, like high, medium, and low samples of work to compare. And maybe they each don't have to bring a high, medium and low if they all feel that, yes, that's kind of a low sample and that kind of fits my class, so definitely to do that and then to bring up concerns or needs.

In practice, the II/USP teacher noted there was "no reflection" in meetings in which the templates were discussed and not enough of a focus on discussions of classroom practice. Teachers did not value the time either, and in some cases saw the time as focused too much on "theory" and not enough "on reality." Another teacher added that the grade-level meetings suffered from the same problems. The result was a perception among the interviewed teachers that the time spent in grade-level meetings was focused much more on "filling out forms" than on talking about how to improve practice.

The role that these templates played within the accountability practices of the school appeared to reinforce teachers' reluctance to engage with the instructional planning process meaningfully. In recognition of the failure of the templates to achieve the desired results, the principal transformed their functions: Teachers ultimately had to set their own goals for each 6-week period, indicate through their templates how they would achieve their goals, and then demonstrate results on benchmark assessments of student learning. This practice reinforced the idea that in fact

the templates were not collaborative constructions at all but instead were a mechanism for holding individual teachers accountable for results.

At Crosswinds, teachers had adopted an approach to teaching reading that was developed by their literacy coach and relied on an array of published and teacher-made instructional materials (including Open Court). The literacy coaches and teachers in the school shared materials developed over many years of teaching and actively sought out new materials that they believed could facilitate students' literacy development. The literacy coach modeled and encouraged an active culture of seeking out, selecting, and adapting resources through discussion with colleagues at Crosswinds. This culture was consistent with the overall approach to literacy taken by the literacy coach. At Crosswinds, the student assessment results collected on a regular basis served a formative rather than summative function. Instead of being used to evaluate individual teachers' performance, teachers and literacy coaches worked together to use the data, which were presented and discussed at the grade level, to evaluate the quality of instruction and to determine which students needed extra help or more individualized instruction.

DISCUSSION AND CONCLUSIONS

The cases of Glade and Crosswinds provide a useful departure point for exploring teacher community as a network through which resources and expertise flow more or less freely, abundantly, and effectively to achieve the goal of improving schools. They also point to the difficulties inherent in attempting to build such a community. As one Glade teacher put it, collaboration only works with "people who understand teachers, who have resources to help us, and where the teachers are aware of them enough and open to that where it works." We believe that these cases support this teacher's observation. We would also argue that facilitating collaboration requires leadership that values teacher expertise, knowledge of the current distribution of resources and expertise in a school, and knowledge of the practices, routines, and artifacts that are in place that explain that distribution. As we have demonstrated, social network analysis, combined with other qualitative data from surveys and interviews, can illuminate these processes and help explain how different levels and types of social capital in a school can facilitate or thwart the implementation of reforms. Below, we review the evidence that this study has yielded regarding the potential utility of social network analysis for research and practice.

ANALYZING THE DISTRIBUTION OF ACCESS TO RESOURCES AND EXPERTISE IN A SCHOOL:

The analysis of the two schools provides evidence that analyzing the internal structure of the school community is necessary to help account for the distribution of access to resources and expertise in a school. Looking only at the amount of time allocated for collaboration and even at the overall level of interaction focused on their schools' initiatives, Glade and Crosswinds appear similar. The Glade principal's reliance on external sources for resources to improve instruction, however, led teachers' interactions to become much more focused on meeting accountability requirements for external grants. Meanwhile, Crosswinds's principal's decision to "circle the wagons" when the district put pressure on the school to change led to a more focused effort to reform that school from within. The social network analysis, furthermore, revealed that although overall interaction levels were similar, there were significant fractures in the Glade school community that did not exist at Crosswinds. Expert-novice interaction at Glade was limited, whereas at Crosswinds, it was both extensive and fluid.

The study provided indirect evidence that teachers' social capital was important in facilitating teacher change. There were large differences between the two schools with respect to teachers' perceptions that they had adequate access to valued resources and expertise. These differences existed even though the overall level of resources available to the two schools was similar. Further, the possible link between ties with others and these perceptions suggests that perceptions of resources are linked to teachers' positions within their school's social network. To the extent that access to resources makes a difference in implementation of reform, it may be that these differences could have contributed to the differences in student outcomes between those two schools. To support that claim, however, a different kind of longitudinal study that included extensive classroom observations of teacher practice would be necessary.

The study also points to some potential lessons for effective collaboration that could be explored in future studies and in interventions designed to enhance or build teacher community. For example, these cases suggest that it may not be a successful strategy for the principal to adopt a view of the school as completely permeable with respect to outside expertise and resources. A successful "buffering" strategy might be one in which high-quality resources are brought in by the principal and faculty members but vetted and adapted through collegial interaction. Further, limiting the number of outside agencies to which schools are held accountable may be an important contributor to schools developing

a clear focus for their collaboration that also allows teachers to focus on improving teaching and not just on filling out forms.

Differences in accountability practices between the two schools affected perceptions of teachers in another way that may have implications for building successful teacher communities. At Glade, teachers were held accountable for results in their individual classrooms; the risk of failure was at the door of every classroom. In a setting in which trust was already low, there was nothing to mitigate teachers' feelings of being under constant pressure to improve without enough resources to support their work. By contrast, at Crosswinds, responsibility was structured in such a way that it was shared across classrooms and primarily at the grade-level subgroups. Accountability for results was distributed but organized around improvements on benchmark assessments, so that no individual felt at risk; rather, risk was shared. Those feelings were likely mitigated by the high level of trust and confidence of the principal. The combination of supportive norms and leadership with shared accountability for results may be one community-building strategy that succeeds in other schools as well.

The network analyses also yielded valuable information about the efficacy of the two reform coaches at these schools. At Glade, the coach fell into a role of "enforcer" or "accountability monitor." She did not appear to serve the function of a bridge between groups—facilitating the flow of expertise and data analysis within and across subgroups in the school—a role that coaches are often expected to play (Neufeld & Roper, 2003). By contrast, our network analysis and interviews together show that a skilled mentor who is knowledgeable in his or her subject area can become an important hub in the school's collegial structure. The coach at Crosswinds was a bridge between different groups in the school, and her expertise served as a source of genuine normative authority for teachers, a person who motivated them to succeed and provided them with useful and valuable resources they could use to improve their practice.

THE PROMISE AND CHALLENGE OF ANALYZING TEACHERS' SOCIAL NETWORKS

We have presented these case studies in an effort to demonstrate the potential value of analyzing teacher communities from a social network perspective on social capital. We believe that our cases illustrate how attending to the distribution of resources and expertise in a school is more useful for explaining the success of two schools' efforts at reform as compared with an examination of overall levels of collaboration. Further, they illustrate how attending to processes through which schools attempt

to facilitate the flow of expertise and resources in a school can either support or undercut the goals of teacher collaboration. At the same time, social network, survey, and interview data have some important limitations that suggest a more constrained role for their use in future studies. We describe those limitations next and offer some broad directions for a research agenda investigating teacher networks.

A key limitation of network data is that the intensive level of effort required to collect data for an entire school means that it would be difficult for researchers studying a particular reform to devote resources to studying particular practices and artifacts in depth, as researchers in the community of practice tradition have. Ideally, much more information about teachers' ties could be gathered, including the degree to which particular relationships are characterized by trust, respect, and mutual regard. Gathering social network data requires ethical sensitivity and imagination, and the safeguards needed to protect research participants from harm add to the time required to collect social network data and determine how best to represent results to research participants (Penuel, Sussex, Korbak, & Hoadley, 2006).

In addition, our analysis here has focused on teachers' networks, with little consideration of the parents and community members or the students who contribute to the life of a school and its ultimate success. A fuller network analysis that takes into account the resources and expertise needed to implement an ambitious reform would consider the resources accessible through these other school actors. In the particular schools we studied, we have reason to believe that the wider communities of which these schools were part were sufficiently different that such a wider analysis might have revealed even deeper differences between the two schools in terms of their social structures and the resources that teachers could draw upon to improve practice.

Despite these limitations, we believe that analyzing teachers' social networks provides a useful context for interpreting case study findings that is now missing from current studies of teacher communities. With Coburn and Russell (2006), we agree that the way social network analysis renders visible the variable internal structures of teacher communities poses a challenge to scholars who look only at the school as a unit of analysis. Similarly, we believe that a social network analysis can provide a useful way to look at the efficacy of an important strategy for advancing reform goals being adopted by a wide range of schools—principally, the use of mentors and coaches to facilitate change in instruction. When integrated into a detailed analysis of the value of expertise and resources obtained through collegial interactions, social network analysis has great potential for explaining and potentially even reducing the wide

variability among teachers benefiting from efforts to promote teacher community.

Intervention development is also needed that is aimed at realizing the practical benefits of social network analysis. At present in education, these benefits have not yet been well researched, and applications for improving practice have not been developed. If innovation in other institutions is a guide, however, there may be opportunities to use social network analysis to provide leaders with information about collaboration across teams (Cross & Parker, 2004) and to help teachers locate people in their own schools with specialized expertise that can help them improve their own teaching (Lamont, 2003). Ultimately, applications like these will need to be developed in education if the promise of social network analysis for research is to be accompanied by practical interventions to support the ongoing work of school improvement.

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Note

1. California's Academic Index is a composite score of academic performance assigned to each school that is based on results of California's Standards Tests. Each test has a different weight assigned to it from year to year, although the weights are the same for all schools in a given year. The scale of the index is from 200 to 1,000, and the target set by the state for each school is 800.

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