Under What Conditions do School Districts Learn from External Partners?

The Role of Absorptive Capacity

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Abstract

School district central offices regularly engage with external partners in improvement efforts, but these partnerships are not always productive. Indeed, little is known about under what conditions partnerships are likely to lead to organizational learning outcomes. We conducted a longitudinal comparative case study of two departments in one urban school district central office, both working with the same external partner. Data included 131 interviews and 372 hours of observations as well as artifacts and social network data. While one department did not incorporate the partner's ideas into policies and routines, the other demonstrated greater integration. We argue this difference is due to organizational conditions that foster absorptive capacity and to the nature of department–partner interactions.

Keywords: absorptive capacity, district central office, external partner, organizational theory, organizational learning

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Today's school districts face significant challenges for ambitious instructional reforms. The implementation of the Common Core State Standards requires major decisions about new instructional materials, assessments, and professional development (PD) for educators. Yet district central offices can suffer from limited capacity to undertake these sorts of tasks. Consequently, many reach out to external partners for assistance (Datnow & Honig, 2008; Honig, 2004b; Marsh et al., 2005; Supovitz, 2008). These partners—including educational vendors, consultants, foundations, and researchers—bring sets of ideas to support instructional improvement (Rowan, 2002; Russell, Knutson, & Crowley, 2013), but the work is not always productive (Firestone & Fisler, 2002; Freedman & Salmon, 2001). Thus, we need a better understanding of the conditions that allow district departments to engage with guidance from external organizations and see changes in district policies or routines.

Here, we bring together organizational theory—especially the concept of absorptive capacity—with existing scholarship on school districts to investigate a district's ability to learn from an external partner. Absorptive capacity is the ability to recognize the value of new information, assimilate it, and apply it in novel ways as part of organizational routines and policies (Cohen & Levinthal, 1990). Although this language may suggest a metaphor of unidirectional knowledge absorption, we focus on learning processes in which organizations make sense of information and construct new knowledge through activity and social interaction (Zahra & George, 2002). We find that the degree to which a district department can leverage an external partner's ideas in policies and routines depends on both organizational conditions and the nature of the interactions between the department and external partner.

This study contributes to our understanding of why some departments in district central offices integrate guidance from external partners in their policies and routines while others do not. We develop a theoretically-grounded conceptualization of the capacity to learn from external sources of knowledge, one that considers interactions among different organizational conditions. The study provides insight into how absorptive capacity can shape how district staff and external partners interact, and with what consequences for organizational learning. In addition to these theoretical contributions, the study informs policy makers, practitioners, and external organizations by identifying points of leverage for more productive partnering.

Literature Review

Policymakers and education leaders are increasingly interested in leveraging external organizations to support district improvement efforts. Indeed, there are many external organizations eager to provide guidance to school districts: consultants, for-profit vendors, local or regional nonprofits, foundation-based projects, and technical assistance centers, to name a few (Burch, 2009; Coburn, 2005; Rowan, 2002; Russell et al., 2013; Trujillo & Woulfin, 2014). Research suggests that external partners can support improvement efforts at scale (Fullan, Bertani, & Quinn, 2004; Glennan & Resnick, 2004; Marsh et al., 2005). However, not all partnerships are beneficial (Firestone & Fisler, 2002; Freedman & Salmon, 2001). For example, external partners can introduce ideas that run counter to other district messages, leading to incoherence and confusion (Hatch, 2001); they can also take a good deal of time and energy (Donovan, Wigdor, & Snow, 2003) and create problems when there are differing timelines, incentives, or norms (Coburn, Bae, & Turner, 2008; Bickel & Hattrup, 1995).

External organizations that engage with school districts can bring different expectations for the work together (Datnow & Honig, 2008; Honig, 2004a; Supovitz, 2008). A district may

contract a partner to do work for the central office, or the explicit goal may be for partners to bring knowledge and expertise that the district wants to incorporate into broader instructional efforts (Honig, Venkateswaran, & McNeil, 2017). In these latter circumstances, an external partner brings a set of ideas related to instructional improvement to district leaders (Honig, 2004a).[1] This guidance may take the form of advice or be embedded in PD sessions, technical assistance, or curricular materials (Ikemoto & Honig, 2010).

There is remarkably little research on the conditions under which these ideas from external partners contribute to shifts in district policies or routines. We do know that district central office capacity can influence the ability to engage with external partners in substantive ways (Honig et al., 2017; Hubbard, 2010). However, we do not yet have a clear conceptualization of *how* capacity shapes a district's ability to integrate ideas from external partners into policies and routines. Moreover, most studies focus on districts as single, monolithic entities, but most district central offices are complex organizations, often with substantial internal variation in types or levels of capacity (Burch & Spillane, 2005; Spillane, 1998) or different kinds of engagements with external organizations (Honig, 2004a). Thus, we need to focus on the district department as the unit of analysis. Finally, few studies investigate how specific kinds of interactions between district staff and partners create different conditions for collective sensemaking and opportunities for learning (Weick, 1995).

We argue that the degree to which a district central office department brings partners' ideas into its policies and routines depends upon the department's absorptive capacity and the nature of the interactions between department and external partner (Figure 1; see Farrell & Cohen, 2017). We explore each of these constructs below.

[INSERT FIGURE 1]

Organizational Learning Outcomes

Scholars argue that organizations are more than the sum of the individuals within them (Easterby-Smith, Crossan, & Nicolini, 2000; Kazemi, 2008; Knapp, 2008; Scott & Davis, 2007). It follows, then, that organizational learning is different from the learning of individual members. Instead, it involves incorporating information into policies and routines that guide organizational behavior (Feldman & March, 1981; Levitt & March, 1988). This definition recognizes that shifts in policies and routines are stretched across individuals (Sherer & Spillane, 2011), may or may not involve individual cognitive change (Coburn, 2006), and can carry on past any one individual's tenure in a given position or within the organization (Hedberg, 1981).[2]

Organizational learning occurs when an external partner's ideas about content, pedagogy, implementation, or ways of organizing work contribute to changes in district policies and routines.[3] We define *policy* broadly, including formal policies as well as rules, plans, and guidelines. If a department were to integrate ideas from a partner into a new initiative, we would consider this to be learning. Likewise, changes in district *routines*—that is, the patterned ways that actors in the central office interact with one another or with schools (Feldman & Pentland, 2003) also indicate organizational learning, as when a partner's ideas are incorporated into PD sessions (Supovitz, 2006; Supovitz & Weathers, 2004). Organizational learning can also occur when a district shifts the structure of its routines, such as adopting a partner's routine for school walk-throughs (Ikemoto & Honig, 2010).

Department Absorptive Capacity

The degree to which a district department can make use of the guidance from an external partner may be related to its ability to engage with external sources of knowledge productively, known as its *absorptive capacity* (Cohen & Levinthal, 1990). Absorptive capacity can contribute

to increased performance (Volberda, Foss, & Lyles, 2010) and innovation (Stock, Greis, & Fischer, 2001). These benefits are cumulative and path dependent; the more absorptive capacity an organization has, the more it benefits from engagement with new knowledge in the future (Cohen & Levinthal, 1990). In education, a number of scholars have recognized the utility of this concept (e.g., Daly & Finnigan, 2010; Honig, 2008; Peurach, Glazer, & Lenhoff, 2016). To date, however, it has not been operationalized in systematic ways.

Several organizational conditions have been shown to foster absorptive capacity: relevant prior knowledge, communication pathways, and strategic knowledge leadership. First, *relevant prior knowledge* is critical. Expertise about a given issue enables a department to better recognize the value of external knowledge and to incorporate it into organizational practices (Cohen & Levinthal, 1989, 1990). We conceptualize prior knowledge as an organizational trait, distributed among multiple individuals in a given organizational unit. In studies of central offices, Honig and colleagues have found that prior knowledge related to partners' expertise is necessary but not sufficient for uptake of partners' ideas (Honig, 2004b; Honig et al., 2014, 2017). Further, relevant prior knowledge likely depends upon the focus of the partnership's work. For instance, if a district engages an external partner to improve mathematics teaching, relevant knowledge for district staff likely includes an understanding of mathematics content, pedagogical strategies, and adult learning (Stein & Nelson, 2003). Finally, relevant knowledge is not helpful if people in the organization are unaware of where it is located (Levitt & March, 1988; Walsh & Ungson, 1991). Most large school district central offices are complex organizational structures (Hannaway, 1989; Meyer, Scott, & Strang, 1987; Spillane, 1998), so knowing where knowledge exists and how to access it can be a challenge.

Second, absorptive capacity depends on the presence of *communication pathways*—formal and informal structures within and between departments that enable people to access, share, make meaning of, and use knowledge to problem solve (Lane, Koka, & Pathak, 2006). With well-developed pathways, there are regular opportunities for communication around a given initiative (Peurach et al., 2016), helping individuals create shared understandings (Gioia & Chittipeddi, 1991; Weick, 1995). Formal structures, like meetings or task forces, can provide opportunities to access relevant knowledge that exists inside and outside a given department (Schwartzman, 1989). Informal social interactions, or social networks, facilitate communication and support district staff as they engage in joint problem solving and collective action (Burt, 2001; Hansen, 1999; Hargadon & Sutton, 1997; Powell & Grodal, 2006). Not all networks are created equal when it comes to contributing to knowledge sharing, however. When a social network spans multiple knowledge pools (e.g., different departments), district staff can access diverse knowledge sources (Burt, 2001; Reagans & McEvily, 2003). Network density, or the overall level of connectedness in a social network, fosters the development of shared understanding (Adler & Kwon, 2002; Hansen, 2002; Reagans & Zuckerman, 2001).

Third, district leaders can play an important role in the degree to which engagement with external sources of knowledge supports organizational learning (Volberda et al., 2010). Key to these efforts is *strategic knowledge leadership*—the ability to identify and assess current sources of knowledge within the department, scan the broader field for available sources of knowledge, and synthesize acquired knowledge by linking it with current knowledge and routines (Van den Bosch, Volberda, & de Boer, 1999; Volberda et al., 2010). In a district department, strategic knowledge leadership could involve leaders' willingness to engage with an external partner, their vision for the role of the partner, and efforts to link knowledge from the partner to existing

efforts. Strategic knowledge leadership is again likely distributed across individuals in a department, but it differs from prior knowledge in its focus on when and how an external partner can be brought in to support district efforts.

Nature of Interaction Between External Partner and District Department

Ideas from an external partner enter into departments through interactions between external partners and district staff. Certain kinds of interactions may support organizational learning by creating opportunities for collective sensemaking (Gioia & Chittipeddi, 1991; Weick, 1995) in which partners and practitioners engage with partners' ideas and support practitioners as they productively adapt the ideas to their settings (Datnow & Park, 2010). We consider three dimensions of the interactions that may matter for organizational learning outcomes: role of the partner vis-à-vis department staff, characteristics of inter-organizational routines, and informal social networks between external partners and district staff.

First, partnerships can be configured differently, with external partners playing particular *roles* in relation to department staff (Datnow & Honig, 2008; Honig, 2004a; Supovitz, 2008). A partner can serve as a service provider—providing trainings, instructional materials, or coaching on an instructional model—doing the majority of the work while district staff coordinate and support the effort (Bryk, Rollow, & Pinnell, 1996). A partner can also serve as a collaborator or co-leader, where the focus of the work is jointly negotiated, and both parties are involved in decision making about the direction of the partnership (e.g., Donovan et al., 2003; Rosenquist, Henrick, & Smith, 2015). A partner can also act as an advisor, providing guidance to district staff who, in turn, design and carry out the work themselves. A given person or organization can shift between these roles when working with a district department.

Second, different arrangements with external partners fit into different *inter-*

organizational routines, shaping who interacts with whom, in what ways, around what sources of knowledge, and with what frequency (Feldman, 2000; Feldman & Pentland, 2003). Routines can be designed or emergent (Feldman, 2000) and can be created by the department, the partner, or both. Routines play a role in what people notice, the meaning they make, and the implications they draw for their work (Sherer & Spillane, 2011; Spillane, Parise, & Sherer, 2010). For this reason, inter-organizational routines can create very different conditions for organizations to learn from engagements with external partners (Dyer & Sing, 1998; Lane, Salk, & Lyles, 2001; Zahra & George, 2002). For example, it may be easier for district staff to integrate guidance from a partner into the design of district policies when they collaborate together regularly, as compared to a routine that is structured around an external partner providing an update on the work. In the former, the guidance of the partner can directly inform the development or redesign of core district policies or routines, whereas in the latter situation the connections to current district policies and routines may be distant or unnamed.

Finally, *informal communication* between district staff and external partners may play a role in inter-organizational engagements (Ghoshal, Korine, & Szulanski, 1994; Walter, Lechner, & Kellermanns, 2007). In addition to engaging with external partners in formal meetings, district staff benefit from on-the-spot opportunities to receive guidance from partners informally (Eraut & Hirsh, 2007), providing for guidance to specific problems in a timely way.

Research Methods

We focused on one district, Cypress School District, and its work with an external partner, Partner for District Improvement (PDI), between 2012 and 2014.[4] We organized our analysis around three guiding questions:

1. What guidance did PDI provide to district departments, and with what consequences for organizational learning outcomes?
2. What was the absorptive capacity of the district departments?
3. What was the nature of the interactions between PDI and district departments?

District Context

Cypress School District was an urban district in California, educating more than 50,000 students every year (see Appendix A for more information). Like other similarly-sized districts, Cypress had a complex central office with multiple levels and departments. Two divisions played a central role in teaching and learning issues: Leadership, and Teaching and Learning (T&L). The Leadership division was responsible for school improvement efforts. It was divided into subdivisions, each headed by a leadership team supporting a group of schools. One division, the Improvement Zone, was a cluster of the district's low-performing schools. T&L was charged with designing curriculum and providing support for teacher learning. It was organized into content-specific departments, including mathematics. As in other districts (Farrell, 2015; Rigby et al., 2017), Leadership and T&L were not well-connected.

Starting in 2012, Cypress began to prepare for the shift to the Common Core State Standards in Mathematics (CCSS-M). The Improvement Zone team focused on adapting a traditional, back-to-basics mathematics program (Math Basics) used by Zone schools to better align to the new standards. This involved designing new PD for K–8 teachers at Zone schools. The mathematics department focused on designing, developing, and piloting instructional materials aligned with CCSS-M. Both departments worked with PDI to support these efforts. PDI had been involved in the district for six years when we began our study. PDI developed partnerships with districts focused on a program of research, design, and development intended

to improve teaching and learning at scale. Staff in both departments were actively engaged in the PDI partnership, seeing it as a valuable resource to advance departmental goals and build capacity.[5]

Studying PDI work with two departments in one district allowed us to hold the partnership and its guidance constant and explore variability in department absorptive capacity and the nature of interactions with an external partner (Yin, 2003). Further, the close proximity of one researcher to the Cypress School District allowed us to do sustained, in-depth observational fieldwork (Barley, 1990). Finally, the two-year duration meant we could analyze shifts in organizational routines and policies over time (Merriam, 1998). We used Year 1 data (2012–2013) as a baseline and investigated the role of department absorptive capacity and interaction with PDI in Year 2 (2013–2014). To assess the consequences for organizational learning outcomes, we investigated changes in policies and routines between Years 1 and 2. Our findings speak to the influence of PDI on policies and routines after a year of intensive work together rather than to PDI's impact since it first began working with the district.

Data Collection and Analysis

Using semi-structured protocols, we conducted 101 interviews with 49 central office staff (see Appendix B). Participants included cabinet-level administrators, supervisors, and teachers on special assignment, each of whom was interviewed once or twice a year between June 2012 and December 2014.[6] Individuals were selected for participation based on involvement in K–12 improvement efforts; they spanned different departments, including mathematics, assessment, English learners, special education, Improvement Zone, and other Leadership departments. In mathematics and the Improvement Zone, we spoke with all staff willing to participate (n = 39

interviews with 13 mathematics staff; 8 interviews with 6 Improvement Zone staff). We also interviewed 12 PDI staff in 30 interviews. All interviews were audiotaped and transcribed.

We observed 372 hours of meetings related to mathematics, including department meetings, planning sessions, and PD sessions. Thirty-four hours of observations occurred with the Improvement Zone team, 222 hours centered on the mathematics department, and the remaining 116 hours included mathematics-focused events hosted by other departments or partners.[7] We created detailed field notes and, on some occasions, videotaped and transcribed meetings. Finally, we gathered 1,826 artifacts, including all relevant documents from the meetings we observed and documents related to district mathematics policy. These documents included meeting agendas, draft and final policy documents, and instructional materials. All data were entered into Dedoose, a software program for qualitative data analysis.

Data Analysis

We used a hybrid method to code our data (Miles & Huberman, 1994), employing both inductive and deductive approaches. We describe our analyses for each research question below.

Q1. What guidance did PDI provide to district departments, and with what consequences for organizational learning outcomes? In interviews, we asked PDI leaders to identify the key ideas they sought to convey during the 2013–2014 school year (Year 2 of the study). We cross-referenced this list with a review of key PDI documents. We selected a subset of the most salient ideas and developed keywords or phrases for each to identify when these ideas came up. We shared these key ideas and keywords with PDI leaders as a member check and revised them accordingly.

To investigate the degree to which these ideas contributed to *changes in department policy* from Year 1 to Year 2, we first identified key policy documents (e.g., instructional

guidance, implementation plans, or policies on course pathways) for each department in each study year. Excluded were early drafts of policy documents, meeting minutes, or other administrative documents. We coded the documents for presence or absence of key ideas from PDI by using the keywords associated with each idea. We reviewed each instance and eliminated those that were irrelevant. Next, we analyzed whether the PDI idea was central to the policy (i.e., the policy was organized around the PDI idea) or peripheral (i.e., the idea was mentioned in passing). Mindful that it is possible for educators to incorporate ideas in ways that might differ from the original intent (e.g., Hill, 2001), we analyzed the degree to which the document sections with the keywords were congruent with PDI's original intentions. Likewise, it may be difficult to directly attribute these ideas to PDI since some are in the broader policy environment; thus, we noted whether or not the documents had an explicit link to PDI or PDI staff. Finally, we compared the presence of PDI's key ideas in policy documents from Year 1 and Year 2 to identify shifts over time.

To investigate *shifts in a department's routines*, we identified the set of central office routines related to mathematics instruction in each department in Years 1 and 2. For the Improvement Zone, this included PD sessions; for the mathematics department, it included the set of work days for teachers who were developing the district's curriculum. Next, we analyzed the content of the enacted routines in both years, looking for the presence and absence of key ideas from PDI, similar to the policy documents analysis described above. We also analyzed changes in district routines between Years 1 and 2 with regard to frequency of meetings, who was involved, and roles played by district staff and partners.

Q2. What was the absorptive capacity of the district departments? We did not assess absorptive capacity directly; rather, we analyzed the organizational conditions in Year 2 that

have been shown to foster absorptive capacity. To understand the distribution of *relevant prior knowledge*, we asked district staff about the main strengths and areas for growth for people involved in CCSS-M work in each department. We identified instances when more than one person in a division identified another individual as having expertise in a given domain, and we excluded self-reports.[8] We focused on the domains of prior knowledge most closely related to the work with PDI: mathematical content knowledge, PD, teaching English learners, and working systemically with schools. We analyzed each domain in each department, assessing whether it was absent or held by a single person or multiple individuals.

To understand *communication pathways* within and between departments in the district in Year 2, we asked district staff to name the mathematics-related meetings they attended on a regular basis. We mapped meeting attendance, analyzing what divisions were represented and which division initiated the meetings. To understand informal social networks, we asked district staff whom they approached with questions about mathematics. We conducted a sociocentric analysis of this data, analyzing all the relationships within a defined social group (e.g., district staff involved in mathematics). From the interviews, we identified who went to whom about mathematics, recording it as an informal tie in the network in UCINET (Version 6.0; Borgatti, Everett, & Freeman, 1999). Next, we extracted each department from the full network and analyzed its density (i.e., the ratio of the number of possible ties to the number of actual ties). To analyze network range, we used Burt's measure of network diversity (Burt, 1983; Reagans & McEvily, 2003).[9] To calculate the range of a given department, we took the average of the range scores of individuals within that department.

To assess distributed *strategic knowledge leadership* in each division, we drew on district staff interview data to identify the main points of contact for the partnership work. We coded the

strategic knowledge leadership activities of these people and their perceptions about the relationship between partnership work and district initiatives. We analyzed PDI staff interviews along similar dimensions in order to triangulate reports between district staff and PDI.

Q3. What was the nature of the interactions between PDI and district departments? To understand the *role of PDI staff*, we analyzed district interviews concerning engagement with PDI and PDI staff using codes derived from the literature about the role of partners (Honig, 2004a) as advisors, collaborators, and service providers.[10] To gain insight into *inter-organizational routines*, we drew on observations of PDI-department meetings. We coded for frequency of interactions, who was involved, topics raised, and the ways people engaged, including opening/closing the meeting, asking questions, summarizing, or presenting. To analyze *informal communication between partners and district staff*, we returned to our social network analysis. We asked district staff to name individuals outside of the district they turned to for mathematics guidance. We also asked the same questions to PDI staff about informal interactions. We partitioned the social networks to include only individuals in each department and PDI. We counted the number of ties between members of each department and members of PDI and found the overall density of each network.

Several methodological features of this project ensure that the themes reported here represent patterns present in the Cypress School District. These include intensive immersion at the research site, efforts to explore divergent evidence, systematic coding of data, and member checks with participants (Eisenhart & Howe, 1992; Miles & Huberman, 1994; Strauss & Corbin, 1990). See Table 1 for a summary of data included in each line of analysis, by research question.

[INSERT TABLE 1]

Findings

We found that the degree to which each of the two departments in the Cypress School District central office learned from PDI was shaped by the department's pre-existing organizational conditions for absorptive capacity and the nature of the department–partner interactions. Below, we outline the key ideas that PDI brought to the work. We argue that there was greater evidence of organizational learning (i.e., shifts in department policies and routines) from Year 1 to Year 2 for the mathematics department than for the Improvement Zone. Finally, we explore how the two departments' organizational conditions for absorptive capacity and interactions with PDI may have mattered for the variation in the organizational learning outcomes observed.

Guidance Provided by PDI

PDI had a core set of ideas they sought to foster in the district. Via interviews, we identified six ideas related to mathematics instruction and three regarding organizational development (see Table 2). The same key ideas were integrated into PD sessions led by PDI staff and were central to tools that PDI shared with the district. For instance, one idea from PDI was related to productive language in mathematics classrooms. In meetings, PDI staff advocated that English learners needed intentional opportunities during mathematics classes to produce mathematical discourse, and this idea formed the basis of PD sessions offered by PDI to teachers.

[INSERT TABLE 2]

Organizational Learning Outcomes

To investigate each department's organizational learning outcomes, we analyzed the degree to which there were changes departmental policies and routines consistent with PDI ideas.

Overall, we found greater evidence of organizational learning for the mathematics department than for the Improvement Zone across the two years of the study.

Changes in policies. From Year 1 to Year 2, the Improvement Zone saw very limited integration of PDI ideas into Zone policy documents (Table 3). In Year 1, we analyzed 13 policy documents, including a professional learning calendar, instructional materials from the Zone's Math Basic program, and Zone mission statements. These documents held almost no PDI ideas, and those present were not congruent with PDI's meaning. In fact, some ideas about mathematics in Year 1 documents ran counter to key PDI ideas. For example, the professional learning materials for Math Basics, the Zone's math curriculum at the time, revealed a primarily teacher-centered, direct instruction approach. This diverged from PDI's emphasis on student–student interactions, student discourse, and sensemaking around mathematics.

[INSERT TABLE 3]

In Year 2 Zone policy documents, we saw a few occurrences of PDI ideas. Of the 11 documents analyzed, three referenced PDI ideas in largely peripheral ways. For instance, one document outlined a PD schedule for the year after our study ended. The document had three key ideas from PDI directly credited to PDI staff, and these ideas were congruent with PDI's guidance. However, the ideas were not a main focus of the overall plan, as they were identified as one of many topics for PD. Thus, while the ideas did show up in the planning documents in ways that were congruent with PDI's original meanings, on the whole not many of PDI's ideas were present in Zone policy documents; the ones that were there did not play a central role, suggesting limited organizational learning.

In contrast, we found a substantial increase in PDI ideas in policy documents for the mathematics department from Year 1 to Year 2 (Table 4), especially for ideas related to

mathematics. Across the 17 documents from Year 1, only three mentioned PDI ideas in ways congruent with PDI's definitions. There was only one mention per document, and the ideas were raised in ways that were peripheral. For instance, the district had developed instructional guides for teachers. These provided an overview of the year's curricular units, organized as a progression of lessons. There were no key ideas from PDI in the units themselves, although the idea of having students discuss each other's strategies, an idea related to "discourse," was offered as an appendix, as an "enhancement" strategy for teaching.

[INSERT TABLE 4]

In Year 2, we found substantial presence of PDI's mathematics ideas in policy documents for the mathematics department. Ideas related to the "importance of discourse," "rich math tasks," "course pathways," and "sensemaking" were present in central ways in at least four of the 22 documents. For instance, in the district's new unit template for all K–12 courses, "rich math tasks" were identified as cornerstones of each unit, with student "discourse" as a key instructional strategy. The mathematics department's mission statement includes the key ideas of "rich math tasks" and "the importance of discourse" in two of their four guiding principles. Further, a new, high-profile policy paper on secondary course pathways used much of the same language expressed by PDI staff, including phrases we heard from them during observations like "acceleration only occurs by course compression."[11] PDI staff were cited by name in the policy paper, increasing our confidence that these ideas could be attributed to PDI. Finally, six of the nine key ideas embedded in mathematics policy documents were congruent with PDI's framing 80% or more of the time. That is, district staff evoked or wrote about these concepts in ways envisioned by PDI staff. Considering how complex some of these ideas were, this is notable.

Changes in department routines. We analyzed the content and structures of the routines in both departments at the end of Year 1 and Year 2, looking for the degree of integration of key ideas from PDI. We analyzed PD meetings offered to Zone teachers and school leaders in both years and found little change in the frequency with which PDI ideas were present as the focal content of PD. There also was little change in the roles district and PDI staff played. In both years, PDI staff were centrally involved as providers of the PDs. Key ideas were almost entirely advanced by PDI staff as they led the sessions, organized activities, and facilitated question and answer periods. We saw no evidence that the Zone team "owned" PDI's ideas independently, adapting the ideas into their own tools or activities either within or beyond the ongoing PD routines.

In comparison, in the mathematics department, we saw significant shifts in routines between Years 1 and 2. Here, we studied a set of work days for teachers who were developing the district's core curriculum. First, there was an increased invocation of a subset of PDI's key ideas (i.e., "the importance of discourse," "sensemaking," and "rich math tasks") in the content of the work days and associated artifacts. These ideas also became more central objectives of the work days. So, in Year 1, teachers were simply exposed to rich math tasks by doing a task in a small group each day. By Year 2, teachers spent most of their time writing or adapting rich math tasks to be included in the core curriculum.

Second, we found a shift in the roles for district and PDI staff, with district staff playing a more central role by Year 2. In the first year, PDI staff were largely responsible for providing PD to teachers in whole group settings, while district staff tended to support small-group activities. By the end of Year 2, however, the mathematics department played a central role in running and leading the work days. At this point, PDI staff played a support role, working with

small groups of teachers or answering questions. Further, the more central role for mathematics staff in Year 2 also meant that PDI's key ideas were more often shared with teachers by district staff, instead of predominately by PDI staff as was the case in Year 1. This suggests greater ownership of PDI's ideas by district staff.

Finally, we saw evidence that mathematics staff began adapting PDI's ideas for the district initiative and needs of the teachers. In Year 1, PDI's ideas were largely presented to teachers either in a large group setting or as part of an activity in which the teachers engaged. By Year 2, district staff bundled PDI's ideas together into tools recognizable and useful for teachers for their own unit development work. For instance, in Year 2, the mathematics department developed a worksheet for teachers regarding the different roles for rich math tasks within a unit, which highlighted PDI's key ideas of the "importance of discourse," "sensemaking," and "rich math tasks." The teachers then drew on this tool as they chose tasks for their units. Organizational learning scholars would point to this as an example of incorporating the external guidance into new solutions and applying it to new problems (Cohen & Levinthal, 1990).

Role of Absorptive Capacity and the Nature of Interactions

As we discuss next, the differences in the incorporation of PDI ideas into each department's policies and routines was related to variation in the organizational conditions that promote absorptive capacity and the nature of interactions between department and partner.

Improvement Zone

Overall, the Improvement Zone had limited organizational conditions that could have supported its ability to learn from PDI in Year 2. Moreover, Zone leaders structured the relationship with PDI as a service provider who came in and delivered PD based on occasional planning meetings with Zone and PDI staff. This provided few opportunities for engagement

with PDI staff in regular collective sensemaking. We discuss these points in turn.

Organizational conditions for absorptive capacity. Organizational conditions in the Improvement Zone collectively made it more challenging to incorporate PDI ideas into department policy and routines. First, we found limited relevant prior knowledge in mathematics instruction (see Table 5). Every member of the Zone team interviewed reported that there was no individual with expertise in mathematics content and pedagogy. As one explained, "We have to get something going in math, and we don't have the expertise. We don't really know what we're doing, but we know we want to start the conversation." At the same time, Zone staff agreed that there were multiple people on the team with strengths in PD, adult learning, and working systemically with schools.

[INSERT TABLE 5]

It was not necessarily surprising that the Zone lacked an in-house source of mathematics expertise. They were in charge of overseeing all school improvement efforts in high-needs schools, and mathematics was just one focus area. Further, the district mathematics department could have served as a resource. Yet, Zone staff had few communication pathways to those in the district with expertise in mathematics. They only occasionally participated in any of the 12 regular meetings hosted by the mathematics department in Year 2, even though they were invited, and leadership of other district departments regularly sent representatives to many of them (see Table 6). The Zone did occasionally have internal meetings where mathematics was discussed. Because the department did not have expertise in mathematics, however, these meetings did not provide substantive access to knowledge about content or pedagogy. In the three Zone meetings we attended without PDI staff, Zone staff facilitated rich conversations with Zone principals around school-level data or literacy efforts. Mathematics topics came up in

passing as staff mentioned upcoming PDs with PDI, but there was no substantial discussion of mathematics teaching or learning.

[INSERT TABLE 6]

Additionally, Zone staff had few informal ties to those with mathematics expertise. Within the department, they did not turn to their Zone colleagues for advice related to mathematics. Thus, the density of their mathematics informal social network was 0 out of a possible 1.0 (see Table 7), suggesting very limited potential that the Zone could access shared knowledge around mathematics from within the department (Adler & Kwon, 2002; Hansen, 2002; Reagans & Zuckerman, 2001).

[INSERT TABLE 7]

There were also limited informal ties with other departments regarding mathematics, as seen in Figure 2. This map of the Improvement Zone's two-step network represents all individuals in the Improvement Zone (represented by triangles), their ties to others in the district (represented by circles)—known in network parlance as alters—and alters' ties with one another. As shown, only one member of the Zone had any ties related to mathematics—in this case, to three individuals in two other departments. Limited connections to other departments meant limited opportunities to benefit from expertise in other parts of the district.

[INSERT FIGURE 2]

One way to measure access to expertise is a metric called network range, or the degree to which a unit has access to multiple knowledge pools (Reagans & McEvily, 2003). Informal ties to units that have many ties to other units make it more likely that a given department has access to knowledge resources from the multiple units. The Improvement Zone had a network range score of .24 out of a possible 1.0, suggesting limited access (see Table 7).

Our interviews with Zone staff confirm our social network findings. One person described Zone staff as "segregated, isolated" from the rest of the district, limiting interactions around mathematics. The absence of relevant prior knowledge is not an insurmountable obstacle to organizational learning if there is regular, ongoing communication with others who do have that expertise. However, our analysis suggests that the Improvement Zone had limited opportunity for that type of communication about mathematics via formal meetings or informal interactions.

Strategic knowledge leadership played an important role in how and why the Zone was removed from mathematics expertise in the district. Zone leaders viewed Zone schools as having very specific and pressing challenges. These schools were among the most segregated and lowest-performing in the district. They had high proportions of new teachers and school leaders, faced significant churn year-to-year, and had implemented a set of different initiatives. Zone leaders did not feel that the guidance offered by the mathematics department was as relevant for Zone schools given these conditions, and they did not see ways to leverage the mathematics department's expertise. Consequently, they limited interactions with the mathematics department, only inviting them to meetings when encouraged to do so by PDI.

Nature of interaction. Zone leaders' strategic knowledge leadership not only influenced their reluctance to reach out to others within the district who had mathematics expertise but also their stance toward work with external partners. After trying to develop improvement plans on their own, the team realized they needed more mathematics guidance. At that point, one leader reached out to PDI for support. She explained, "I have some expertise that I bring, but it's the absence of [the mathematics knowledge of the PDI leader] and other people who know this deeply.…That's why we went for [PDI staff]. I want to mainline some expertise!" She involved

others on her team in the work with PDI to build capacity of the team as a whole. She explained: "PDI is always focused on building independence.…The tone of PDI is always for us to be better prepared to do something."

Zone leaders structured the partnership so that PDI was a service provider, providing content for PD sessions that the Zone team helped plan. Throughout their interactions, Zone leaders played a role in coordination and support while PDI staff did the majority of the work related to planning and leading PD trainings. Inter-organizational routines were characterized by joint brainstorming about the focus of the PD, with planning and execution left to PDI. In the six planning sessions we observed, Zone staff contributed updates about the most pressing problems they observed in Zone schools and made requests that certain topics (e.g., use of manipulatives) be included. However, PDI took the lead in identifying learning objectives and in planning activities. Further, although PDI staff frequently brought up information related to adult learning and CCSS-M, including substantial references to research findings or research-based resources, the information was not discussed in depth. Finally, Zone staff met relatively infrequently with PDI staff for these meetings; only one planning session was scheduled in advance of each of the six PD sessions. Even if the meetings had been structured differently or had involved different roles, the light touch of this engagement may not have provided enough time for Zone staff to engage with PDI's ideas and connect them substantively to their ongoing work.

Finally, there were few informal ties between the Zone team and PDI staff. One of the four Zone staff involved in mathematics had an informal tie with one PDI staff member. The between-group density of the PDI–Improvement Zone dyad was .026 out of a possible maximum of 1.0 (Table 7). These limited informal ties suggest there were few opportunities outside of PD planning meetings for Zone staff to learn from and with PDI staff.

Summary. The Improvement Zone had limited mathematics expertise and few connections to other expertise in the district. Zone leaders preferred to reach out to external partners for expertise instead of those within the district with mathematics expertise. Zone leaders structured the relationship with PDI such that PDI met with Zone leaders for guidance, but trainings were largely designed and led by PDI. These conditions, along with limited informal contacts with PDI, resulted in few opportunities for collective sensemaking around PDI's ideas. These conditions help to account for the limited integration of PDI's ideas into Zone policies and routines.

Mathematics Department

In contrast to the Zone, the organizational conditions of the mathematics department likely supported its ability to engage productively with PDI, and they worked together in ways that enabled PDI's work to be closely linked to the department's agenda. These conditions facilitated the ability of the mathematics department to incorporate PDI guidance into policies and routines.

Organizational conditions for absorptive capacity. The mathematics department had a deep bench of expertise. As shown earlier in Table 5, colleagues agreed that multiple individuals had expertise in mathematics content knowledge and PD. Department staff also identified expertise in issues related to English learners and providing PD. At the same time, department staff agreed that no one in the department had knowledge about working systemically with schools or issues of scale. For example, one mathematics staff person said, "Our team has a hard time mapping out multiple-year projects. They're very good at designing engaging [PD] days, but actually turning an encyclopedia entry into a novel will be hard."

Further, the mathematics department had extensive communication channels to share

relevant knowledge within the department. There were multiple formal meetings in place that brought together individuals to work collaboratively, including monthly mathematics department meetings and weekly or biweekly subcommittee meetings focused on assessment, PD, and unit development. Members of the mathematics department also had multiple informal ties to one another.[12] The majority sought out multiple colleagues to get advice on mathematics; only one person in the department was an isolate. The social network within the mathematics department had a density of .23 (out of 1.0) (Table 7). Greater density of ties is associated with the development of shared ideas (Adler & Kwon, 2002).

The mathematics department had robust communication channels with other units in the district, which likely provided access to additional expertise and enhanced its ability to problem solve and coordinate action. First, the department hosted a dozen regular or semi-regular meetings with representatives from other district departments, including representatives from the high school and middle school divisions, as well as the assessment, professional learning, and English learning departments (Table 6). Colleagues from these other departments brought diverse knowledge into deliberations about mathematics policy and planning. Mathematics department staff participated in seven meetings hosted by other departments during which they received feedback on their plans and coordinated with other district staff.

Further, members of the mathematics department had ample informal ties with others in departments related to mathematics issues (Figure 3). They had informal connections to a large number of individuals in other district units (represented by circles), including the research and assessment division and all three divisions that supervised elementary, middle, and high schools. These connections likely enabled coordination with those departments. Mathematics leaders also created access to multiple knowledge pools, as reflected in their network range score of .5 (Table

7). Indeed, interviews with district mathematics staff suggest their connections provided access to knowledge about working systemically with schools, which they said they lacked in house. For example, one person talked about his relationship with an elementary assistant superintendent: "I reach out to [the assistant superintendent] on structure. How do we get into the schools?…Do we have to concentrate on content or on pedagogy at the elementary level?" This leader then brought this guidance to bear when planning PD for schools.

[INSERT FIGURE 3]

Strategic knowledge leadership played an important role in the development of communication channels that provided access to knowledge within and across departments. Mathematics leaders hosted a monthly mathematics meeting that focused on planning and implementation of the district's mathematics core curriculum. They expanded membership to bring in additional expertise to build a curriculum that was inclusive of all populations. As one mathematics leader explained, "Initially, [the monthly math meeting] was just the math people. Then, we started opening it up, and there's representation from the various departments." On this and other occasions, mathematics staff created access points to relevant knowledge across departments through formal meeting spaces.

Nature of interaction. Mathematics leaders' strategic knowledge leadership also influenced their stance toward work with external partners. Early on, the department experienced shifts in leadership. Prior to these personnel changes, the mathematics department had many partnerships; some were only loosely tethered to the district's agenda. One new leader explained that, when he arrived, "there were 12 partners in math! There's no internal definition of the math program in [the district], so it's been defined by the partners who've come in to fill

in." The new leadership felt the presence of so many partners was problematic given the district's goals for mathematics.

This strategic knowledge leadership also influenced the roles that PDI staff played vis-à-vis district staff. New leaders developed and communicated a philosophy that external partners needed to work in service of the district's initiatives, and partners needed to structure their interactions to intentionally build district staff capacity. The department created new criteria for evaluating how each partner aligned to the district's strategic plan and what value they brought. This resulted in phasing out some partners and renegotiating the roles of others, including PDI.

During the first year of our study, PDI had engaged with the mathematics department through a series of collaborations with a small number of people (described by one as "small boutique projects") and as a service provider for PD trainings. After the review process, mathematics leaders pushed for a shift in PDI's role. One leader explained that the relationship between PDI and the mathematics department would be more "narrow…where they [PDI] could reflect, give their opinion about it, give advice on it, bring expertise to the table." This reformulation of PDI's role influenced how PDI and district staff interacted in Year 2. Instead of providing trainings or engaging on more peripheral projects, PDI leaders focused their efforts as advisors to district staff. In the majority of Year 2 interviews, mathematics staff described PDI as providing guidance for mathematics work or acting as a collaborator, "a member of the team."

One could imagine a range of inter-organizational routines associated with an advisor role. In this case, PDI staff embedded within the mathematics department's regular meetings, providing advice that could directly feed into the district's ongoing efforts. Of the 18 mathematics meetings we observed in Year 2, PDI staff attended five. District staff organized and led the meeting, and the majority of talk time was spent discussing the district's current

problems and projects. PDI staff interjected ideas related to learning under the new standards, research-based pedagogical principles, or implementation strategies for the new curriculum. Consequently, PDI brought advice to bear on the mathematics department's most salient issues. Further, in 10 of the 13 meetings where PDI staff were not present, mathematics staff directly referenced PDI staff in their conversations. In some cases, it involved ventriloquizing PDI staff's ideas (Bakhtin, 1986), as was the case when one staff member noted, "It's like [PDI leader] says…." Other times, we saw mathematics staff reference documents from PDI or ideas from conversations they had with PDI staff. So, even though frequency of attendance at mathematics department meetings was relatively low, PDI and its ideas were invoked often, even when PDI staff members were not physically present—another indicator of the partner's influence.

Staff from PDI and the mathematics department also had significant informal relationships, which likely enabled the spread of ideas as well. Social network analysis showed that multiple members of the mathematics department had ties with multiple members of PDI's staff (Table 7). The PDI–mathematics department between-group density was .132, somewhat higher than the PDI–Zone density of .026. Also noteworthy was that PDI staff had informal network ties with multiple people positioned at different layers in the department hierarchy, creating multiple pathways for informal engagement.

Summary. The mathematics department had a combination of strong knowledge of mathematics content and pedagogy and of PD, along with well-developed informal networks with other departments, enabling access to knowledge not held in house. The department had strategic knowledge leadership that emphasized bringing diverse knowledge to the table. These leaders set the expectation that work with any partner would be in service of department goals and initiatives, laying the groundwork for interactions with PDI. Consequently, in their work

together, PDI staff played an advising role, participating in the mathematics department's central meetings where leaders could make sense collectively of PDI ideas in the context of their ongoing work. The significant informal relationships between PDI staff and mathematics department staff likely enabled the spread of ideas as well. This broad set of conditions help us understand the central presence of PDI's ideas in mathematics policies and routines.

Conclusions and Implications

Ambitious instructional reforms often require district central offices to reach out to external partners for guidance. Yet few studies have systematically analyzed the conditions under which a district learns from these partners as they adapt or integrate guidance into policies or routines. We found important differences in organizational learning outcomes between two departments in one district engaged with a partner focused on building capacity around mathematics. After a year of work together, PDI's ideas remained largely absent from the Improvement Zone's policies and routines but were present in mathematics department policies and in the content and structure of its routines. We argue that this difference is due, in part, to organizational dimensions that foster absorptive capacity and the nature of interactions between each department and its partner.

This analysis contributes to our theoretical understanding of district capacity and organizational learning in several ways. First, we provide evidence about how relevant prior knowledge, communication pathways within and between departments, and strategic knowledge leadership are critical for understanding how departments are differentially positioned to integrate external knowledge into policies and ongoing routines. Further, the organizational dimensions that support absorptive capacity are not additive, but instead interact and work in combination with each other. Consequently, it is important to consider the presence of expertise,

communication pathways within and between departments, and the nature of strategic knowledge leadership when assessing a department's readiness to engage with a partner. Our analyses also highlight how the nature of partner–district interactions can create opportunities for collective sensemaking that contribute to organizational learning outcomes. Rather than conceptualizing these relationships as simple knowledge transfer, interactions between district departments and a partner are interactive spaces in which district staff can make sense of information through social interaction (Zahra & George, 2002). Finally, strategic knowledge leadership played a role in influencing the nature of interactions with PDI, setting up this partner to participate as a service provider or advisor and shaping how these roles and interactions changed over time.

It is worth considering alternative explanations for the patterns we observed. For example, differences in organizational learning outcomes may be related to each department's broader responsibilities and position within the central office. The mathematics department was responsible for mathematics for the whole district, whereas the Zone was responsible for *all* school improvement efforts in a small number of high-needs schools. From the literature on school improvement, however, we know that districts or clusters of schools can do meaningful work on subject-specific instructional efforts with external partners (e.g., see Cobb & Jackson, 2011; Cobb, Jackson, Henrick, & Smith, 2018; Elmore & Burney, 1997; Honig, 2009; McLaughlin & Mitra, 2001). A future study could further test whether subject-matter departments are simply better positioned than those tasked with broad school improvement to learn from external partners focused on subject matter, regardless of absorptive capacity.

A second alternative theory is that differences in organizational learning outcomes result from different levels of interest or will to engage in the partnership. That is, the limited organizational learning outcomes in the Zone might be attributable to Zone leadership lacking

the will to invest in the partnership. However, Improvement Zone staff initiated the relationship with PDI to support their efforts, whereas the new leaders of the mathematics department inherited the partnership from the prior leaders. Moreover, had there been a lack of will among Zone leaders, we might have expected themes of hesitation or disinterest in interviews—yet we saw the opposite. From interviews, it was clear that Zone staff valued the partnership and were invested in it; one leader called PDI one of her "favorite partnerships" and explained that she "never missed a meeting."

This study points to several directions for future research. First, the two departments had different levels of absorptive capacity conditions *and* different ways of engaging with PDI. Consequently, we are unable to identify the "leading" condition for the observed organizational learning outcomes. Future work could examine one department working with two partners with different modes for interacting to try to parse the contributions of these different conditions. Second, it is likely that organizational learning may contribute to the development of absorptive capacity over time. For example, new routines could create communication channels in or between departments, thus contributing to the organizational conditions that foster absorptive capacity. As such, departments with absorptive capacity are better able to develop more absorptive capacity over time (Cohen & Levinthal, 1989, 1990; Zahra & George, 2002). It follows, then, that the absence of these organizational conditions—say, a lack of relevant prior knowledge—could be a big barrier to a department's ability to engage productively with an external partner in the first place. Future work could look at the degree to which these conditions need to be in place early on and identify promising strategies that help build the conditions necessary for absorptive capacity when initially absent or limited.

Other future research efforts could focus on external partners. PDI was one provider, offering the same guidance to both departments with a goal for building capacity. A future project could explore organizational learning outcomes when there are different kinds of partners involved. For instance, when an external partner is inflexible or rigid, the trust necessary for knowledge sharing is likely limited (Lane, Salk, & Lyles, 2001). A future study could involve partners with differing degrees of flexibility to understand how this shapes interactions with district leaders, and with what consequences for organizational learning outcomes. Second, the nature of the guidance shared by the partner may contribute to shifts in policies or routines. It may be that some ideas are "stickier" in certain circumstances than others (Szulanski, 1996). Or, ideas may move differently through a department if they are embedded in tools such as protocols for classroom observation, curricula, or assessments. Studies that explicitly investigate the qualities of the external partner and its guidance would enrich our understanding of what allows a district to draw on and use external knowledge from partners in more or less productive ways.

Beyond these scholarly contributions, this study can inform practice. By identifying specific organizational conditions that promote absorptive capacity, it highlights key points of leverage for those who seek to increase districts' abilities to engage with external guidance in productive ways. The findings may cue district leaders to consider what expertise is necessary before a partnership begins. When an initiative touches multiple departments, leaders might devise cross-departmental or cross-functional meetings to increase access to relevant prior knowledge. Or, district leaders might consider their approach to strategic knowledge leadership, deliberately connecting to available expertise already within the district or scanning the environment to identify a partnership to provide relevant guidance or support. It may also involve leaders considering their own vision for partners vis-à-vis a department's work or being

clear about the expectations for an appropriate role for the partners as compared to district staff.

These findings may also be useful for external partners as they consider relationships with different district departments and the degree to which a department is well-positioned to integrate external knowledge. Assessing the conditions likely to support or undermine absorptive capacity may be useful for a partner when deciding whether to work with a new group. Further, with the knowledge that the design of inter-organizational routines may matter for organizational learning outcomes, an external partner could think critically about how its roles or routines for interacting shape what district administrators take away from the engagement.

Ultimately, central office–partner relationships are complicated affairs. Productive relationships involve the presence of several critical organizational ingredients for the department involved. These conditions interact in ways that position the department to be able to take advantage of the partner's guidance. Partnerships also require interactions that encourage and enable district departments to engage with an external partner's ideas in meaningful ways. Together, this set of conditions can contribute to shifts in district policies and routines—outcomes that can potentially outlast any individual district leader.

Notes

1. Ideas are not the only thing an external partner brings to its work with a district. For example, the partner can bring certain ways of engaging that may or may not mesh well with the district's work.

2. There is a long debate in the literature about the relationship between individual and organizational learning. Some argue that organizational learning is the aggregation of individuals' learning. Others argue that organizational learning occurs at the group level, taking into account a specific community structure or activity structure (see Easterby-Smith, Crossan, & Nicolini, 2000; Kazemi, 2008; Knapp, 2009; & Scott & Davis, 2007.) Our study is not designed to resolve this longstanding debate. Rather, we acknowledge that it is possible that individual

learning may have contributed to the organizational learning outcomes we documented, but we did not investigate this conjecture directly.

3. Others have sought to understand the social processes underlying organizational learning. Here, we focus on organizational learning outcomes—that is, the shifts in the policies and routines in a department.

4. This study was a part of a larger, two-year project focused on decision making in three districts working with external partners. We use pseudonyms for the partner, district, and participants.

5. PDI work with the mathematics department was funded by an external grant, while work with the Improvement Zone was supported by Improvement Zone funds.

6. All district staff we approached agreed to participate in the interviews. Because of turnover and availability issues, however, we did not obtain the same number of interviews from all participants.

7. Both departments were very generous and open to us attending their meetings. We observed more hours of meetings in the mathematics department, however. This is because they met more regularly around issues related to mathematics teaching and learning, creating more opportunities for observation.

8. Reports of prior knowledge should be interpreted with caution because individual district staff members may only have partial knowledge about the areas of expertise held in their department. Future research should explore other ways of surfacing the distribution of prior knowledge in a district setting.

9. An individual's network range is a function of two things: (a) the diversity of connections, measured by the number of different groups to which they are connected, and (b) how cohesive those groups are. Network range increases with a greater number of ties to more loosely connected groups that also have many ties to external groups. When groups are more cohesive and insular, they tend to share redundant information (Burt, 1992; Reagans & McEvily, 2003). A person's range score will increase as their number of ties to different groups increases, as they connect to more loosely connected groups, or both. A person with fewer ties to a couple of diversely connected groups will have a higher range score than a person with more ties to insular, strongly connected groups.

10. Of course, these different roles may involve different power relationships, which may influence whether and how district personnel engage with ideas from an external partner (Coburn, Bae, & Turner, 2014). Our data did not allow us to investigate this possibility, so it is an important focus for future research.

11. Prior to this policy, students could accelerate by skipping over grade content (e.g., skipping Grade 8 mathematics and going to Algebra from Grade 7 mathematics). Here, PDI proposed that students could instead take a course that compressed material—for example, covering Grades 7 and 8 mathematics in a single course in Grade 7.

12. It is likely that attendance at formal meetings encouraged the development of informal ties (Coburn & Russell, 2008). We did not investigate this directly, as it was beyond the bounds of this analysis.

References

Adler, P. S., & Kwon, S. (2002). Social capital: Prospects for a new concept. *Academy of Management Review, 27*, 7–40.

Bakhtin, M. M. (1986). *Speech genres and other late essays* (V. W. McGhee, Trans.). Austin, TX: University of Texas Press.

Barley, S. R. (1990). Images of imagine: Notes on doing longitudinal field work. *Organization Science, 1*, 220–247.

Bickel, W. E., & Hattrup, R. A. (1995). Teachers and researchers in collaboration: Reflections on the process. *American Educational Research Journal, 32*, 35–62.

Borgatti, S. P., Everett, M. G., & Freeman, L. C. (1999). UCINET [Computer software]. Natick, MA: Analytic Technologies.

Bryk, A. S., Rollow, S. G., & Pinnell, G. S. (1996). Urban school development: Literacy as a lever for change. *Educational Policy, 10*, 172–201.

Burch, P. E. (2009). *Hidden markets*. New York, NY: Routledge, Taylor & Francis.

Burch, P. E., & Spillane, J. P. (2005). How subjects matter in district office practice: Instructionally relevant policy in urban school district redesign. *Journal of Educational Change, 6*, 51–76.

Burt, R. S. (1983). The network structure of social capital. *Research in Organizational Behavior, 22*, 345-423.

Burt, R. S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.

Burt, R. S. (2001). Attachment, decay, and social network. *Journal of Organizational Behavior, 22*, 619–643.

Cobb, P., & Jackson, K. (2011). Towards an empirically grounded theory of action for improving the quality of mathematics teaching at scale. *Mathematics Teacher Education & Development*, *13*(1), 6–33.

Cobb, P., Jackson, K., Henrick, E., & Smith, T. M. (2018). *Systems for instructional improvement: Creating coherence from the classroom to the district office.* Cambridge, MA: Harvard Education Press.

Coburn, C. E. (2005). The role of nonsystem actors in the relationship between policy and practice: The case of reading instruction in California. *Educational Evaluation and Policy Analysis, 27*, 23–52.

Coburn, C. E. (2006). Framing the problem of reading instruction: Using frame analysis to uncover the microprocesses of policy implementation. *American Educational Research Journal, 43*, 343–379.

Coburn, C. E., Bae, S., & Turner, E. O. (2008). Authority, status, and the dynamics of insider–outsider partnerships at the district level. *Peabody Journal of Education, 83*, 364–399.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The two faces of R&D. *The Economic Journal, 99*, 569–596.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*, 128–152.

Daly, A. J., & Finnigan, K. S. (2010). A bridge between worlds: Understanding network structure to understand change strategy. *Journal of Educational Change, 11*, 111–138.

Datnow, A., & Honig, M. I. (2008). Scaling up teaching and learning improvement in urban districts: The promises and pitfalls of external assistance providers. *Peabody Journal of Education, 83*, 323–327.

Datnow, A., & Park, V. (2010). Success for all: Using tools to transport research-based practices to the classroom. In C. E. Coburn & M. K. Stein (Eds.), *Research and practice in education: Building alliances, bridging the divide* (pp. 77–91). Lanham, MD: Rowman & Littlefield Publishers.

Donovan, M. S., Wigdor, A. K., & Snow, C. E. (2003). *Strategic education research partnership*. Washington, DC: National Research Council.

Dyer, J., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review, 23*, 660–679.

Easterby-Smith, M., Crossan, M., & Nicolini, D. (2000), Organizational learning: Debates past, present and future. *Journal of Management Studies, 37*, 783–796.

Eisenhart, M. A., & Howe, K. R. (1992). Validity in educational research. In M. D. LeCompte, W. L. Millroy, & J. Preissle (Eds.), *The handbook of qualitative research in education* (pp. 643–680). San Diego, CA: Academic Press.

Elmore, R. F., & Burney, D. (1997). *Investing in teacher learning: Staff development and instructional improvement in Community School District 32, New York City*. New York, NY: National Commission on Teaching and America's Future.

Eraut, M., & Hirsh, W. (2007). *The significance of workplace learning for individuals, groups and organizations*. Oxford, England: Economic & Social Research Council Centre on Skills, Knowledge and Organisational Performance.

Farrell, C. C. (2015). Designing school systems to encourage data use and instructional improvement: A comparison of educational organizations. *Educational Administration Quarterly, 51*, 438–471.

Farrell, C. C., & Coburn, C. E. (2017). Absorptive capacity: A conceptual framework for understanding district central office learning. *Journal of Educational Change*, *18*, 135–159.

Feldman, M. S. (2000). Organizational routines as a source of continuous change. *Organization Science, 11*, 611–629.

Feldman, M. S., & March, J. G. (1981). Information in organizations as signal and symbol. *Administrative Science Quarterly, 26*, 171–186.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly, 48*, 94–118.

Firestone, W. A., & Fisler, J. L. (2002). Politics, community, and leadership in a school–university partnership. *Educational Administration Quarterly, 38*, 449–493.

Freedman, R., & Salmon, D. (2001). The dialectic nature of research collaborations: The relational literacy curriculum. In T. Ravid & M. G. Handler (Eds.), *The many faces of school–university collaboration: Characteristics of successful partnerships*. Englewood, CO: Teacher Ideas Press.

Fullan, M., Bertani, A., & Quinn, J. (2004). New lessons for districtwide reform. *Educational Leadership, 61*(7), 42–46.

Ghoshal, S., Korine, H., & Szulanski, G. (1994). Interunit communication in multinational corporations. *Management Science, 40*, 96–110.

Gioia, D., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic Management Journal, 12*, 433–448.

Glennan, T. K., & Resnick, L. B. (2004). School districts as learning organizations: A strategy for scaling education reform. In T. K. Glennan Jr., S. J. Bodilly, J. Galegher, & K. A. Kerr (Eds.), *Expanding the reach of education reforms: Perspectives of leaders in the scale-up of educational interventions* (pp. 517–564). Santa Monica, CA: RAND Education.

Hannaway, J. (1989). *Managers managing: The workings of an administrative system*. Oxford: Oxford University Press.

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly, 44*, 82–111.

Hansen, M. T. (2002). Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organization Science, 13*, 232–248.

Hargadon, A., & Sutton, R.I. (1997). Technology brokering and innovation in a product development firm. *Administrative Science Quarterly, 42*, 716–749.

Hatch, T. (2001). Incoherence in the system: Three perspectives on the implementation of multiple initiatives in one district. *American Journal of Education, 109*, 407–437.

Hedberg, B. (1981). How organizations learn and unlearn. In P. Nystrom & W. H. Starbuck (Eds.), *Handbook of Organizational Design* (Vol. 1). London: Cambridge University Press.

Hill, H. C. (2001). Policy is not enough: Language and the interpretation of state standards. *American Educational Research Journal, 38*, 289–318.

Honig, M. I. (2004a). District central office–community partnerships: From contracts to collaboration to control. In W. K. Hoy & C. G. Miskel (Eds.), *Educational administration, policy, and reform: Research and measurement* (pp. 59–90). Greenwich, CT: Information Age.

Honig, M. I. (2004b). The new middle management: Intermediary organizations in educational policy implementation. *Educational Evaluation and Policy Analysis, 26*, 65–87.

Honig, M. I. (2008). District central offices as learning organizations: How sociocultural and organizational learning theories elaborate district central office administrators' participation in teaching and learning improvement efforts. *American Journal of Education, 114*(4), 627–664.

Honig, M. I. (2009). "External" organizations and the politics of urban educational leadership: The case of new small autonomous schools initiatives. *Peabody Journal of Education, 3*, 394–413.

Honig, M. I., Venkateswaran, N., & McNeil, P. (2017). Research use as learning: The case of fundamental change in school district central offices. *American Educational Research Journal, 54*, 1–34.

Honig, M. I., Venkateswaran, N., McNeil, P., & Myers-Twitchell, J. (2014). Leaders' use of research for fundamental change in school district central offices: Processes and challenges. In K. S. Finnigan & A. J. Daly (Eds.), *Using research evidence in education: From the schoolhouse door to Capitol Hill* (pp. 33–52). New York, NY: Springer.

Hubbard, L. (2010). Research to practice: The case of Boston Public Schools, Education Matters and the Boston Plan for Excellence. In C. E. Coburn & M. K. Stein (Eds.), *Research and practice in education: Building alliances, bridging the divide* (pp. 55–72). Lanham, MD: Rowman & Littlefield.

Ikemoto, G. S., & Honig, M. I. (2010). Tools to deepen practitioners' engagement with research: The case of the Institute for Learning. In C. E. Coburn & M. K. Stein (Eds.), *Research and practice in education: Building alliances, bridging the divide* (pp. 93–108). Lanham, MD: Rowman & Littlefield.

Kazemi, E. (2008). School development as a means of improving mathematics teaching and learning. In K. Krainer & T. Wood (Eds.), *Participants in mathematics teacher education* (pp. 209-230). Rotterdam Netherlands: Sense.

Knapp, M. S. (2008). How can organizational and sociocultural kearning theories shed light on district instructional reform? *American Journal of Education, 114*(4), 521-539.

Lane P. J., Koka, B. R., & Pathak, S. (2006). Reification of absorptive capacity: A critical review of rejuvenation of the construct. *Academy of Management Review, 31*, 833–863.

Lane, P. J., Salk, J. E., & Lyles, M. A. (2001). Absorptive capacity, learning, and performance in international joint ventures. *Strategic Management Journal, 22*, 1139–1161.

Levitt, B., & March, J. G. (1988). Organizational learning. *Annual Review of Sociology, 14*, 319–340.

Marsh, J. A., Kerr, K. A., Ikemoto, G. S., Darilek, H., Suttorp, M., Zimmer, R. W., & Barney, H. (2005). *The role of districts in fostering instructional improvement: Lessons from three urban districts partnered with the Institute for Learning*. Santa Monica, CA: RAND Education.

McLaughlin, M. W., & Mitra, D. (2001). Theory-based change and change-based theory: Going deeper, going broader. *Journal of Educational Change, 2*, 301–323.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass.

Meyer, J. W., Scott, W. R., & Strang, D. (1987). Centralization, fragmentation, and school district complexity. *Administrative Science Quarterly, 32*, 186–201.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.

Peurach, D. J., Glazer, J. L., & Lenhoff, S. W. (2016). The developmental evaluation of school improvement networks. *Educational Policy 30*, 606–648.

Powell, W. W., & Grodal, S. (2006). Networks of innovators. In J. Fagerberg, D. C. Mowery, R. R. Nelson (Eds.) *The Oxford handbook of innovation* (pp. 56–85). Oxford, England: Oxford University Press.

Reagans, R., & McEviliy, B. (2003). Network structures and knowledge transfer: The effects of cohesion and range. *Administrative Science Quarterly, 48*, 240–267.

Reagans, R., & Zuckerman, E.W. (2001). Networks, diversity, and productivity: The social capital of corporate R&D teams. *Organization Science, 12*, 502–517.

Rigby, J. G., Larbi-Cherif, A., Rosenquist, B. A., Sharpe, C. J., Cobb, P., & Smith, T. (2017). Administrator observation and feedback: Does it lead towards improvement in inquiry-oriented math instruction? *Educational Administration Quarterly*, 53(3), 475–516.

Rosenquist, B. A., Henrick, E. C., & Smith, T. M. (2015). Research–practice partnerships to support the development of high quality mathematics instruction for all students. *Journal of Education for Students Placed at Risk, 20*, 42–57.

Rowan, B. (2002). The ecology of school improvement: Notes on the school improvement industry in the United States. *Journal of Educational Change, 3*, 283–314.

Russell, J. L., Knutson, K., & Crowley, K. (2013). Informal learning organizations as part of an educational ecology: Lessons from collaboration across the formal–informal divide. *Journal of Educational Change, 14*, 259–281.

Schwartzman, H. B. (1989). *The meeting: Gatherings in organizations and communities*. New York, NY: Plenum Press.

Scott, W. R., & Davis, G. F. (2007). *Organizations and organizing: Rational, natural, and rational system perspectives.* London, England: Routledge.

Sherer, J. Z., & Spillane, J. P. (2011). Constancy and change in work practice in schools: The role of organizational routines. *Teachers College Record, 113*, 611–657.

Spillane, J. P. (1998). State policy and the non-monolithic nature of the local school district: Organizational and professional considerations. *American Educational Research Journal, 35*, 33–63.

Spillane, J. P., Parise, L. M., & Sherer, J. Z. (2010). Organizational routines as coupling mechanisms: Policy, school administration, and the technical core. *American Educational Research Journal, 48*, 586–619.

Stein, M. K., & Nelson, B. S. (2003). Leadership content knowledge. *Educational Evaluation and Policy Analysis, 25*, 423–448.

Stock, G. N., Greis, N. P., & Fischer, W. A. (2001). Absorptive capacity and new product development. *Journal of High Technology Management Research, 12*, 77–91.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage.

Supovitz, J. A. (2006). *The case for district-based reform: Learning, building, and sustaining school improvement*. Cambridge, MA: Harvard Education Press.

Supovitz, J. A. (2008). Melding internal and external support for school improvement: How the district role changes when working closely with external instructional support providers. *Peabody Journal of Education, 83*, 459–478.

Supovitz, J. A., & Weathers, J. M. (2004). *Dashboard lights: Monitoring implementation of district instructional reform strategies*. Philadelphia, PA: Consortium for Policy Research in Education.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal, 17*, 27–43.

Trujillo, T., & Woulfin, S. (2014). Equity-oriented reform amid standards-based accountability: A qualitative comparative analysis of an intermediary's instructional practices. *American Educational Research Journal, 51*, 253–293.

Van den Bosch, F. A. J., Volberda, H. W., & de Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge enviornment: Organization forms and combinative capabilities. *Organization Science, 10*, 551–568.

Volberda, H. W., Foss, N. J., & Lyles, M. A. (2010). Absorbing the concept of absorptive capacity: Realize its potential in the organization field. *Organization Science, 21*, 931–951.

Walsh, J. P. & Ungson, G. R. (1991). Organizational memory. *The Academy of Management Review, 16*(1), 57-91.

Walter, J., Lechner, C., & Kellermanns, F. (2007). Knowledge transfer between and within alliance partners: Private versus collective benefits of social capital. *Journal of Business Research, 60*, 698–710.

Weick, K. E. (1995). *Sensemaking in organizations*. Thousand Oaks, CA: Sage.

Yin, R. K. (2003). *Case study research* (3rd ed.). Thousand Oaks, CA: Sage.

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review, 27*, 185–203.

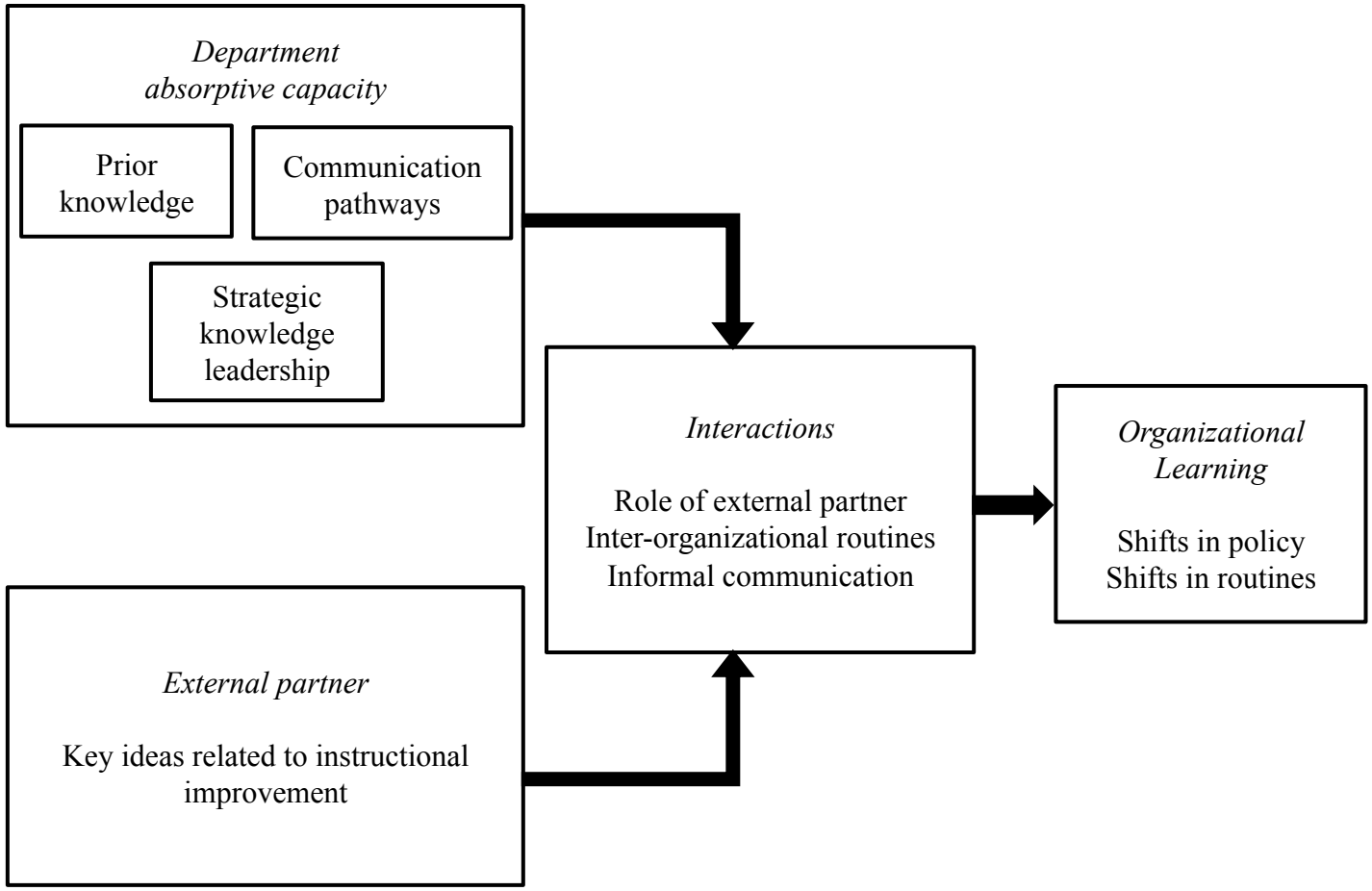

Figure 1. Conceptual framework, adapted from Farrell and Coburn (2017).

Table 1

Data Included in Analysis, By Research Question

	Q1. What guidance did PDI provide to district departments, and with what consequences for organizational learning outcomes?	Q2. What was the absorptive capacity of the district departments?	Q3. What was the nature of the interactions between PDI and district departments?
Interviews			
District staff and leaders		X	X
PDI staff	X	X	X
Observations			
District	X	X	
District–PDI interactions			X
Artifacts related to mathematics			
District artifacts	X		X
PDI artifacts	X		

Table 2

Description of Key Ideas from PDI and Associated Words and Phrases

Key idea	**Elaboration**	**Example key words and phrases**
Mathematics		
Importance of discourse	Mathematical discourse is central in classrooms. Teachers should bring to the surface the variety of thinking that students bring to the classroom. Students should have the opportunity to understand the thinking of others and better explain their own thinking. Students should be held accountable for understanding each other's thinking. Students should revise their thinking.	Second sentence, talk about other students' ideas, discourse, dialogue, revise thinking, make differences visible, students listening to students
Sensemaking, not answer getting	Students should be engaged in sensemaking about mathematics, not simply in finding the answer to math problems.	Sense-making, answer getting, go slow to go deep, problem stems
Using student thinking to move toward mathematical goal(s)	Teachers should elicit student thinking and orchestrate discussion to enable students to develop more and more complex mathematical thinking and reasoning. They should make differences in mathematical thinking visible in order, from least to most mathematically mature. Teachers can then use variability in students' thinking to move students toward on-grade learning.	Make thinking visible, selecting student explanations, least to most mathematically mature, divergent thinking, mathematical target, mathematical goal

Importance of rich math tasks	Teachers should use rich math tasks. These tasks can be used to access student thinking, enable classroom discussion, and provide teachers with opportunities to hear the development of their mathematical reasoning.	Rich math tasks, chunky math problems, diagnostic lesson
Productive language use	Bilingual or multilingual learners need opportunities for productive language use.	Productive language, academic language, 3 read strategy
Course pathways	In response to CCSS, the district needed to determine how to adjust from an Algebra for All in eighth-grade policy to a course pathway that involved CCSS in eighth grade. In response, PDI shared these ideas: If students wanted to accelerate, they could no longer skip eighth-grade standards. CCSS-M Grade 8 standards are essential content. Acceleration would have to occur through compression, not skipping. Students and parents should be involved in decisions about compression; schools should not be in the business of placing students.	Student choice, not placement, compression to accelerate, no skipping content, can't skip content
Adapting former math program*	Math Basics has a good implementation model that gets teachers in different classrooms to do the same thing with monitoring from coaches and school leaders. Rather than remove Math Basics away all together, educators should build on what was good about Math Basics; it creates commonality across classrooms and structure. Educators can use Math Basic's direct instruction approach when appropriate.	Math Basics, building on what works
Organizational development		
Strategic center for decision making at central office	Districts should understand the pathways by which people in the district office influence schools and teachers. Districts should strive to organize themselves for greater coordination and collaboration in supporting schools. Finding a balance between maintaining the autonomy of each school and directing from the top is key. Further, PDI has a multilevel strategy that impacts the district as a system by addressing issues at the central office, school leader, teacher, and student levels. Also important is the idea of policy coherence across different levels of the system (i.e., central office, schools, classroom).	Strategic center, lines of communication, mapping the system, seeing the system, feedback loop, multiple levels of the system
Continuous improvement	Continuous improvement processes can be effective levers for organizational improvement. This involves district leaders identifying a problem of practice, identifying its contributing factors, targeting some of these factors as a way to address the larger problem, and collecting data to inform improvement efforts.	Continuous improvement, root cause analysis, gap analysis, fishbone diagram
Knowledge management	Knowledge lives within the school system, and district leaders need to attend to where it is housed and who is responsible for institutional memory.	Where knowledge lives, where knowledge is housed, institutional memory, knowledge management

***** This key idea was only included in the Improvement Zone analysis.

Table 3

PDI's Key Ideas in Improvement Zone Policy Documents at Year 1 and 2

	Year 1 (n=13 policy documents)				Year 2 (n=11 policy documents)			
Key idea	Number of policy documents	Number of overall mentions	Number of central mentions	% congruent with PDI meaning	Number of policy documents	Number of overall mentions	Number of central mentions	% congruent with PDI meaning
Importance of discourse	0	0	0	0	1	1	0	100
Sensemaking	0	0	0	0	1	1	0	100
Using student thinking	0	0	0	0	1	1	0	100
Strategic center	1	1	0	0	1	1	0	100
Adapting former math program*	1	1	0	0	1	1	0	100
Continuous improvement	1	2	0	0	1	2	0	0
Rich math tasks	0	0	0	0	0	0	0	0
Course pathways	0	0	0	0	0	0	0	0
Productive language use	0	0	0	0	0	0	0	0
Knowledge management	0	0	0	0	0	0	0	0
Total policy documents with any mention of PDI idea	2				3			

*****This key idea was only included in the Improvement Zone analysis.

Table 4

PDI's Key Ideas in Mathematics Policy Documents at Year 1 and 2

	Year 1 (n=17 policy documents)				Year 2 (n=22 policy documents)			
Key idea	Number of policy documents	Number of overall mentions	Number of central mentions	% congruent with PDI meaning	Number of policy documents	Number of overall mentions	Number of central mentions	% congruent with PDI meaning
Importance of discourse	2	6	0	50	6	15	4	100
Sensemaking	1	2	0	0	4	7	5	100
Using student thinking	1	1	0	100	1	4	1	100
Strategic center	0	0	0	0	2	3	0	67
Continuous improvement	3	7	0	0	4	71	0	13
Rich math tasks	0	0	0	0	7	13	4	100
Course pathways	1	1	0	100	4	11	4	100
Productive language use	1	1	0	100	4	7	0	86
Knowledge management	0	0	0	0	0	0	0	0
Total policy documents with any mention of PDI idea	4				20			

Table 5

Relevant Prior Knowledge in the Improvement Zone and Mathematics Department

Domain	Individuals with expertise in this domain in the Improvement Zone	Individuals with expertise in this domain in the mathematics department
Mathematics content or pedagogical knowledge	Absent	Multiple
Professional development and adult learning	Multiple	Multiple
Teaching English learners	N/A; The Improvement Zone served few English learners.	Multiple
Working systemically with schools	Multiple	Absent

Table 6

District Meetings About Mathematics That Departments Hosted or Attended

	Improvement Zone	Mathematics Department
Hosted by department	2	12
Hosted by other units that department staff regularly attended	0	7

Table 7

Informal Social Interactions Around Mathematics for Departments

	Improvement Zone	Mathematics Department
Within-department density The ratio of possible ties to actual ties in department*	0	.23
Cross-department network range The number of outside units a given department was connected to via informal ties and how densely connected those outside units were with one another*	.24	.5
Between-group density of PDI–department The number of ties between PDI and department compared to the number of potential ties, after block partitioning ties from full network*	.026	.132

* Maximum value is 1.0

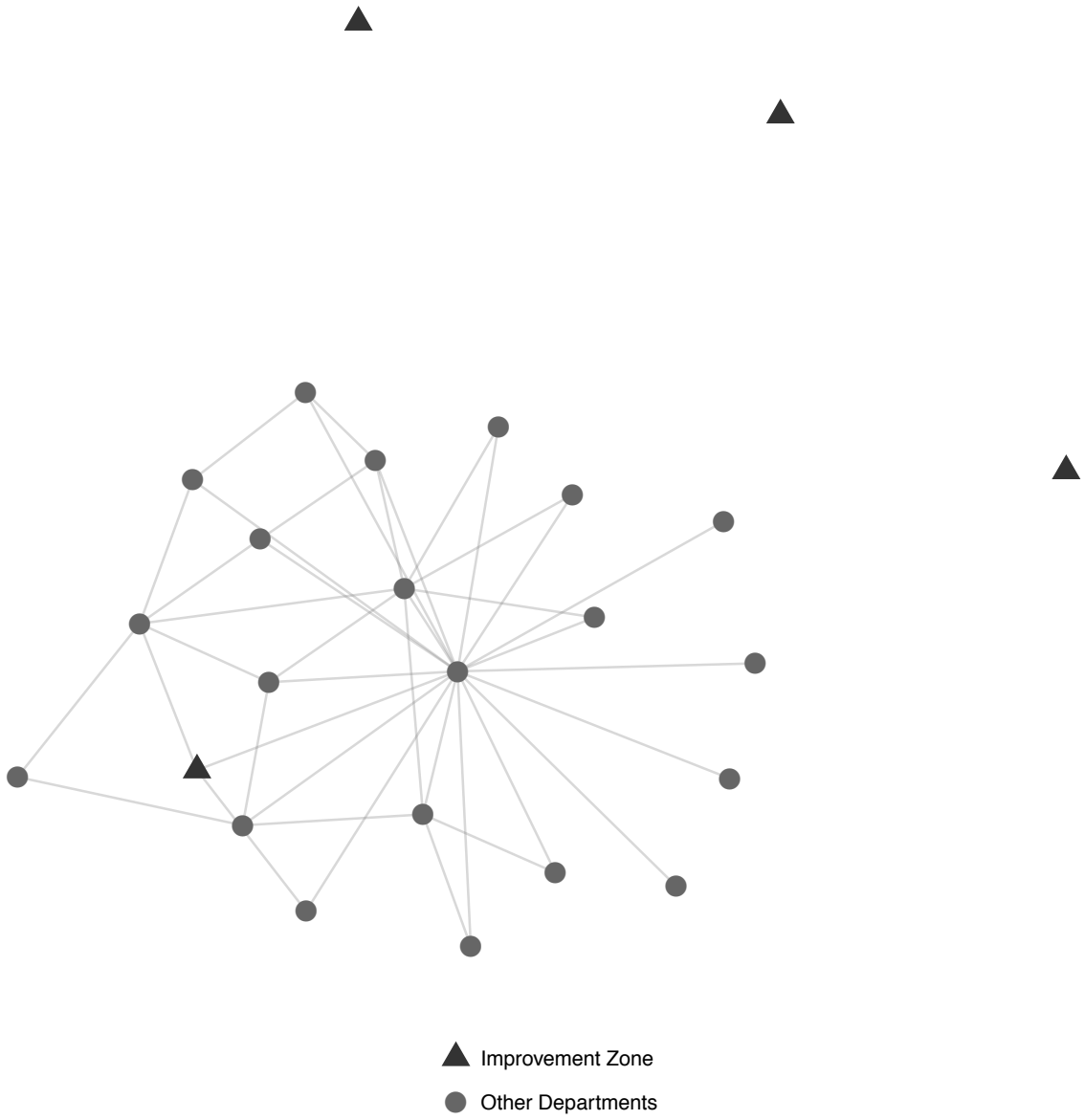

Figure 2. Improvement Zone's two-step mathematics network.

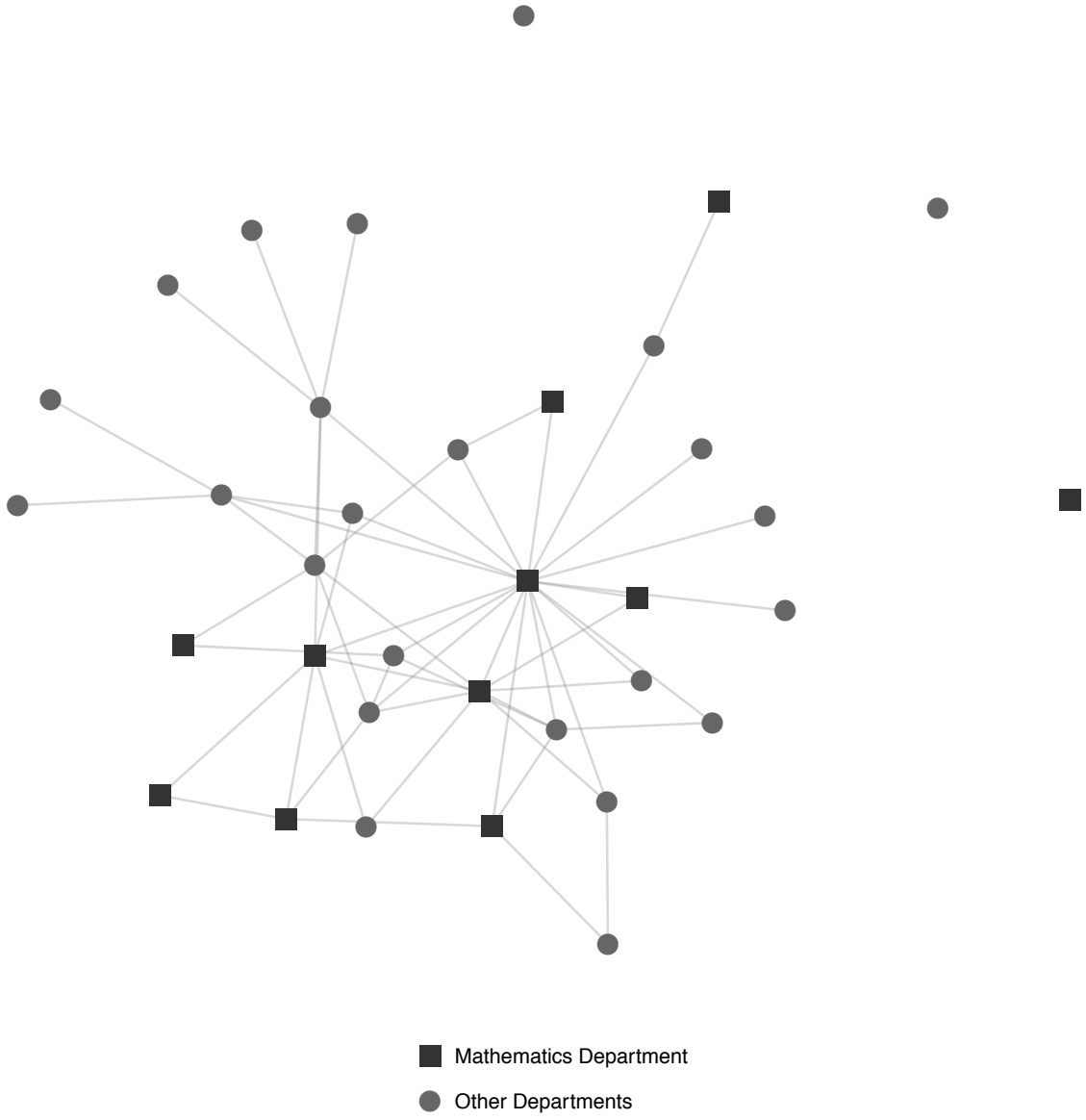

Figure 3. Mathematics department's two-step network.

Appendix A

Characteristics of Cypress School District*

	Cypress
Total Number of Students	55,000
Percentage of Students by Race/Ethnicity	
Asian or Asian American	35
Black or African American	10
Hispanic or Latino	25
Native American or American Indian	<1
White	15
Multi-racial	10
Declined to state	5
Percentage of English Learners	30
Percentage Eligible for Free or Reduced-Price Lunch	55

*Numbers are adjusted to preserve anonymity of the district, but basic proportions remain the same.

Sources: National Center for Education Statistics Common Core of Data, Federal Education Budget Project

Appendix B

Relevant Interview Questions

1. Who are the main people who are working on this issue in your division?

2. What do you see as the main strengths of the people involved in the CCSS-M? [Probe for]:
    a. Mathematical content knowledge (e.g., deep knowledge around CCSS content standards)
    b. Mathematical pedagogical knowledge (e.g., deep knowledge around mathematical standards of practice and how they are enacted in the classroom)
    c. Implementation knowledge (e.g., how this particular program gets implemented in a school/classroom)
    d. Adult learning/professional development knowledge (e.g., ability to coach, lead PLCs, provide trainings)
    e. Other related skill sets (e.g., knowledge of social justice/equity issues; technology; curriculum/assessment development; English learners)

3. What are areas for growth for the people who are involved in the CCSS-M work?

4. Have you involved any external partners in this work?
    a. If so, who?
    b. For each partner: What role are they playing?

5. Who is the main point person for working with this partner? How do they interact with this person (how often, what venue)?

6. [For each partner] What is your vision for how the work with the external partner contributes to your CCSS-M work?
    a. How, if at all, are you connecting this work to other district initiatives?
    b. How, if at all, are you connecting the work of partners together?
    c. What resources, time, skill is necessary to work with partners in this way?
    d. What additional resources, time, skill would help in coordinating this work?

7. Tell me about the ways in which you communicate with T&L on issues related to mathematics?

8. Tell me about the ways you communicate with other departments or subunits on issues related to mathematics?

9. Are there others in the district that you communicate with on issues related to mathematics? Are there others outside of the district?