Designing and Deploying A Professional Learning Community (PLC) Organizational Routine: Bureaucratic and Collegial Arrangements in Tandem

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Over three decades local, state, and federal policy makers in the United States have focused on classroom teaching and learning, specifying what teachers should teach and acceptable levels of student achievement. Standards, accompanied by more or less aligned student assessments that are in turn tied to high-stakes accountability mechanisms, have become staples in state and federal policy-making. These changes in the US education sector are not historically unique, nor are they particular to US education policymaking. While researchers disagree on the efficacy of these policy shifts, most agree that they have had profound impact on local school systems, schools, and classrooms (Au, 2007; Clotfelter & Ladd, 1996; Herman, 2004; Mintrop & Sunderman, 2009; Valli & Buese, 2007). Broadly, the standards and accountability movement has (among other things) influenced the content teachers teach by marginalizing untested or low-stakes subjects, diverting resources to students based on their likelihood of passing the test, and increasing the time devoted to teaching test-taking skills (Amrien & Berliner, 2002; Booher-Jennings, 2006; Darling-Hammond, 2004; Diamond & Spillane, 2004; Firestone, Mayrowetz, & Fairman, 1998; Jacob, 2005; McNeil, 2002; Nichols & Berliner, 2007; Smith, 1998; Valenzuela, 2004; Wilson & Floden, 2001). There is also some evidence that standards and accountability have increased student achievement, though variation between states is tremendous and the evidence with respect to narrowing racial/ethnic and other achievement gaps is weak (Jacob, 2005; Lee, 2007; Mintrop & Sunderman, 2009; Neal & Schanzenbach, 2007; Wong, Cook, & Steiner, 2009).

Most research on these policy changes has centered on their effects – whether good, bad, or indifferent – on teacher practice and on student achievement. However, scholars have mostly ignored how the standards and accountability movement has influenced efforts to *design* and *redesign* the local school district and school instructional guidance infrastructure (IGI) (Hopkins & Spillane,

2014; Spillane, Parise, & Sherer, 2011) intended to support instruction, maintain instructional quality, and lead instructional improvement. Embedded in this changed US education sector, local school districts and schools, long portrayed as buffering teachers from external interference on instructional matters, are working to recouple government policy about instruction, school administration, and classroom instruction. A key component of their recoupling efforts involve redesigning the instructional guidance infrastructure of local school systems and schools (Cohen & Moffitt, 2009; Cohen, Peurach, Glazer, Gates, & Goldin, 2013; Cohen & Spillane, 1992; Hopkins, Spillane, Jakopovic, & Heaton, 2013; Spillane *et al*., 2011). This outcome of the standards and accountability movement has mostly gone undocumented, yet it represents a considerable transformation of local schools' and school systems' instructional guidance infrastructure (IGI).

One key aspect of local school districts' and schools' efforts to redesign their IGIs in response to standards and accountability movement is the design and deployment of organizational routines (Feldman & Pentland, 2003) to monitor instruction, increase instructional transparency, and support teachers' on- the-job learning (Sherer & Spillane, 2011; Spillane & Anderson, 2013; Spillane *et al*., 2011). An *organizational routine* is "a repetitive, recognizable pattern of interdependent actions, involving multiple actors" (Feldman & Pentland, 2003, p. 95), and can include routines for teacher hiring and supervision, lesson study and learning walks, as well as grade-level or department meeting routines. While organizational routines are often portrayed in the empirical and theoretical literature as inhibiting change and contributing to inertia, recent work points to how organizational routines can also enable change in organizations (Feldman & Pentland, 2003; Spillane *et al*., 2011). In this paper, we empirically examine one US local school system's efforts to redesign their elementary schools' instructional guidance infrastructure for mathematics instruction, focusing on the design and deployment of a Professional Learning Community (PLC) organizational routine intended to enable teachers' on-the-job learning by encouraging teacher collaboration. Our research questions are: (1) How does a local school system design and deploy a PLC organizational routine? and (2) How does the PLC organizational routine shape interactions among teachers *about mathematics instruction* over time?

Empirically, we describe the PLC organizational routine as it was designed and deployed by local school system policymakers, and show how the PLC routine in practice shaped interactions among teachers about mathematics instruction. Theoretically, we show how, in the implementation and performance of the PLC routine, bureaucratic and collegial arrangements worked in tandem to support teachers' on-the-job interactions, and by extension learning, about mathematics instruction. Hence, our paper makes two contributions: First, we contribute to a small but growing literature on how school systems work to (re)design their instructional guidance infrastructures to support instruction and its improvement, with particular attention to the role of organizational routines. Second, we

contribute to the literature on PLCs to show how educational policymakers and school leaders use research on PLCs to inform the design and deployment of a new organizational routine system-wide and to what effect and how.

Situating the Work

Redesigning School System Infrastructure: The Role of the Organizational Routine

Over just a quarter century, local school systems and schools in the US have been increasingly pressured by state and federal policies to motivate and support teacher learning in order to transform instruction and student learning. Though state governments have all the constitutional authority for education in the US, local governments in the form of local school districts or Local Education Agencies (LEAs) are the key administrative unit. Local school districts not only make instructional policy, but also are responsible for implementing and administering state and federal education policies and programs. Even as state and national standards, accompanying student assessments, and high-stakes accountability have become commonplace, local school districts in the United States continue to be critical to instructional policymaking (Spillane, 1996). Indeed, in this changed education sector, local district policymakers and school leaders have mostly been left alone to forge connections between policy and instruction and to do so in an education system where "loose coupling" and "decoupling" were long considered the norm (Bidwell, 1965; Meyer & Rowan, 1977; Weick, 1976). In this context, scholars cast school administrators as buffering teachers from government policy (Firestone, 1985; Gamoran & Dreeben, 1986), and the "egg crate" metaphor captured teachers as isolated and independent actors (Tyack & Cuban, 1997).

More recent scholarship, however, suggests that US school districts and schools are recoupling policy, school administration, and instruction in response to standards and accountability policy (Hallett, 2010; Spillane *et al*., 2011). Specifically, schools and school districts have redesigned their instructional guidance infrastructures to support teachers' efforts to learn from and implement, for better or worse, new instructional policies (Coburn, Mata, & Choi, 2013; Coburn & Russell, 2008; Cohen *et al*., 2013; Hopkins & Spillane, 2014; Sherer & Spillane, 2011; Spillane & Coldren, 2011). Recent efforts to press for more intellectually demanding instruction, such as national Common Core State Standards (CCSS) in language arts and mathematics, have further increased pressure on schools and school districts to redesign their instructional guidance infrastructures to support teacher implementation of these reforms.

This instructional guidance infrastructure redesign work involves everything from the adoption of curricula to the creation of leadership positions (e.g., instructional coaches) and the design and deployment of organizational routines (Hopkins *et al*., 2013; Spillane & Diamond, 2007; Spillane *et al*., 2011). Organizational routines are important components of instructional reform

efforts because they can frame and focus interactions among staff (Feldman & Pentland, 2003; March & Simon, 1958; Nelson & Winter, 1982), and these interactions can support learning and knowledge development. Scholars have long recognized that teachers learn and develop new knowledge not only through professional development (Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet *et al.*, 2010), but also through their on-the-job interactions with peers (Eraut & Hirsh, 2007; Horn, 2005; Little, 1993; Parise & Spillane, 2010; Smylie, 1995). Teachers' everyday encounters are generally understood to be important sources of learning from and about instruction and instructional re-form (Coburn, 2001; Little, 1990; Spillane, 1999), and this on-the-job learning from peers can positively influence teachers' classroom productivity as mea-sured by student achievement (Jackson & Bruegmann, 2009).

Analytically, organizational routines have two aspects: an ostensive and a per-formative aspect (Feldman & Pentland, 2003; Latour, 1986). The ostensive as-pect refers to "the ideal or schematic form of a routine… the abstract, genera-lized idea of the routine," (Feldman & Pentland, 2003, p. 101), and is essential for guiding practice in different times and places (Blau, 1955). It is this aspect that more or less enables and constrains practice. The performative aspect re-fers to "the routine in practice," as people co-perform the routine at particular times and in particular places (Feldman & Pentland, 2003, p. 101). While the ostensive aspect structures interactions among organizational members, co-per-formances of the routine can bring changes in the ostensive aspect, providing a framework for understanding the duality of agency and structure (Feldman & Pentland, 2003; Sewell, 1992).

The Professional Learning Community as an Organizational Routine

In this paper, we frame the Professional Learning Community in the school district we studied as an organizational routine. We do so for both pragmatic and theoretical reasons. First, the PLCs we studied, as described by school district leaders and teachers, closely resembled the organizational routine construct defined in the literature as a repeated and recognizable pattern of interaction (Feldman & Pentland, 2003). Moreover, though the conceptualization and mea-surement of PLCs vary (Horn, 2005; Sleegers, den Brok, Verbiest, & Moolenaar, 2013; Vescio, Ross, & Adams, 2008), scholars identify five essential characte-ristics of PLCs (Bolam, McMahon, Stoll, Thomas, & Wallace, 2005; Louis, Kruse, & Bryk, 1995; McLaughlin & Talbert, 2001; Newmann, Marks, & Gamoran, 1996) that closely align with the organizational routine construct: (1) ongoing collaborations among school staff; (2) a constant focus on student lear-ning; (3) de-privatization of classroom instruction; (4) reflective deliberations focused on curriculum, teaching, and student learning; and (5) shared norms of collective responsibility for student learning. These characteristics distinguish PLCs from 'pseudo-communities' (Grossman, Wineburg, & Woolworth, 2001) where a "culture of niceness" (Hargreaves, 2000, p. 812) pervades interactions among peers and "contrived collegiality" (Hargreaves & Dawe, 1990, p. 230)

is the standard operating procedure (Achinstein, 2002; Horn, 2005; Pfeiffer & Featherstone, 1996). In framing the PLC initiative as an organizational routine, we capture the efforts of the school district we studied to deploy the routine in a manner that minimized contrived collegiality. Indeed, there is some evidence that the creation of and participation in PLCs is associated with changes in school culture and teaching practice (for review, see Vescio *et al*., 2008).

Second, while the PLC construct has figured prominently in scholars' efforts to study teachers' on-the-job learning through peer interactions, no studies to our knowledge have framed the PLC as an organizational routine that is situated within a broader instructional guidance infrastructure. By framing the PLC as an organizational routine, we conceptualize the school district's efforts as a case of school systems's work to design and deploy a routine that transforms organizational work practice, or the interactions among organizational members that support learning and collaboration. In doing so, we situate our work in the literature on the role of organizational routines in transforming work in organizations, thereby demonstrating how scholarship in education on PLCs, and indeed other singular reform initiatives (e.g., Lesson Study, Instructional Rounds, Learning Walks), can go beyond the particularized sub-literatures on those initiatives to consider how they are embedded within a broader organizational framework. Although PLCs are not always designed and deployed as they were in the district we studied (and so framing them as organizational routines may not always be appropriate), we believe that PLCs (and other educational reforms) can and should be framed as cases of something broader; in our paper school system and organizational routines. By understanding them as such, research on PLCs (and other reform initiatives) can make a larger contribution to the social science literature.

Organizational Routines in Practice: The Clash of Bureaucratic and Collegial Arrangements

Our examination of one school district's design and implementation of a PLC organizational routine revealed how the use of a bureaucratic structure fostered collegial arrangements that supported teachers' learning about mathematics instruction. The interaction between these bureaucratic and collegial arrangements that we describe below represents something of an anomaly within educational scholarship, where these arrangements are typically depicted as either separate and distinct or in tension. Indeed, the emergence of standards and accountability in the US surfaced tensions, especially on matters of instruction, as bureaucratic arrangements interfaced with established collegial and professional arrangements (Achinstein & Ogawa, 2006; Hallett, 2010; Kersten, 2006; Spillane & Anderson, 2013).

While bureaucratic and collegial arrangements have similarities, with both emphasizing the importance of technical rationality and competence for the attainment of goals, and both with specialized task structures, there are differences between bureaucratic and collegial structures on matters of authority

(Waters, 1989). Whereas collegial arrangements emphasize autonomy, equality, and consensus, bureaucratic arrangements are based on hierarchy, rules, and individual accountability. (We use the term "bureaucratic" here in the theoretical rather than the pejorative everyday sense.) Collegial arrangements are fundamentally rooted in a view of teaching as non-routine, unpredictable work that requires expertise and collaboration across organizational levels; in these circumstances, teachers' "commitment" to one another, as opposed to bureaucratic arrangements, are centrally important to maintaining cohesion (Rowan, 1990). In contrast, organizational designs that focus on "control" emphasize that teaching is a routine technology that can be rationally and predictably managed, and that more bureaucratic and hierarchical arrangements are best suited to manage teaching and learning (Rowan, 1990). Historically in the US, schools and school systems have involved both weak bureaucratic and weak collegial control on matters of instruction (Rowan, 1990).

The rise of high stakes accountability placed emphasis on bureaucratic arrangements, shifting some authority for instructional decision making from individual schools and teachers to state and district policymakers. Although collegiality may have limited resources to resist these bureaucratic arrangements (Waters, 1989), especially in education (Dreeben, 2005; Ingersoll, 2003; Lortie, 1975), teaching is still an unpredictable and knowledge-intensive practice, especially the intellectually ambitious instruction advanced by recent reforms (Cohen, 2011). In organizations that undertake unpredictable and knowledge-intensive work, collegial arrangements are still needed (Lazega, 2001; Rowan, 1990). Additionally, historically teaching *in the US* has mostly *not* been organized around strong collegial control exercised through clear agreed on professional norms and standards for instructional practice (Little, 1990; Lortie, 1975; Rowan, 1990). Rather, historically teaching in the US has been organized mostly as a 'cottage industry' practiced by individual teachers in the relative isolation of their individual classrooms. So, while education systems increasingly mandate bureaucratically, if selectively, what teachers should teach, the local delivery of instruction simultaneously relies on collegial arrangements, with school leaders and teachers left to determine how to deliver instruction in a generally flat organizational structure where staff, with the exception of the principal, share a similar position in the organizational hierarchy. Taken together these observations suggest that in practice, the success of bureaucratic arrangements likely depends in important measure on collegiality; and on a collegiality that may have to be developed as it may not already exist. Indeed, some empirical accounts document a subtle cooptation, rather than outright resistance, of collegial structure by bureaucratic ones (Lazega, 2001). In this paper, we explore how one local school district used bureaucratic and collegial logics in conjunction as they deployed the PLC organizational routine to support efforts to redesign their instructional guidance infrastructure in mathematics.

Research Methodology

Our analysis is based on data from a longitudinal study of a mid-sized US school district, referred to as Auburn Park (AP), serving a predominantly white population of 5,852 students in 14 elementary schools (kindergarten to grade six) during the 2012-2013 school year. All elementary school teaching and administrative staff filled out a School Staff Questionnaire (SSQ) annually from 2010 to 2013, which included questions pertaining to organizational culture, advice and information interactions with colleagues, and staff background. To study school staff interactions, we focused our analysis on social network items that were previously developed, piloted, and validated (Pitts & Spillane, 2009; Pustejovsky & Spillane, 2009). Respondents were asked two questions: "Who are your *closest colleagues* in your school?" and "During this school year, to whom have you turned to for advice and/or information about curriculum, teaching, and student learning?" Respondents nominated up to 12 individuals for each question by entering first and last names. For the second question, respondents also indicated the content area related to the advice and/or information they sought from each person: mathematics, reading/English language arts, and other. For both questions, respondents were asked to indicate how often they interacted with each person listed, from once per year (1) to daily (4). Given the district's emphasis on redesigning their infrastructure for elementary mathematics instruction, we focus our analysis on mathematics interactions. We use the 2013 data, as response rates were highest in that year, with 384 of 410 school staff members responding to the survey (a 94% overall response rate), and school-level response rates varying from 87% to 100%.

Based on the survey results, we purposefully sampled school staff members in five schools for interviews, selecting schools in order to maximize variation in terms of the student population served by the school and to capture variation in the organizational infrastructure for mathematics instruction. Specifically, we selected both schools that served students from low income families and schools that did not, because students' socio-economic background and teachers' beliefs about students from different backgrounds are important influences on classroom instruction (Diamond & Spillane, 2004; Spillane, 2001). Further, we selected schools to represent a range of organizational infrastructures for mathematics, such as schools with and without math coaches, as prior work suggests this was likely to be an important influence on interactions among school staff about mathematics (Spillane, Kim, & Frank, 2012).

In each school, we conducted interviews with school staff members in order to better understand how and why they interacted about mathematics instruction, and to identify the content of these interactions. We interviewed the principal and four to seven teachers per school, for a total of 33 interviews. We interviewed either the coach or the lead mathematics teacher in each school; we also included teachers from different grades, as well as teachers who were integrated and some who were isolated in their school mathematics advice and information networks, as determined by our survey data analysis. We also interviewed

the district's director of elementary curriculum and the district's instructional facilitator, focusing on district infrastructure and redesign efforts related to mathematics instruction. To ensure comparable data was collected across subjects and sites, we used a semi-structured interview protocol that outlined the questions to be asked of each informant under five categories: (1) experiences working in the school; (2) job assignments and responsibilities in the school; (3) instructional advice and information interactions in math; (4) influences of these interactions on instructional practices; (5) general patterns of advice and information-seeking in math at the school. Further, two researchers conducted all of the interviews, with each researcher assigned to complete all interviews at particular school sites, so as to minimize interviewer effects. Interviews lasted 40-50 minutes and were audio recorded, transcribed verbatim, and imported to NVivo 9 for analysis. Our findings rely mostly on the qualitative data, with the quantitative data serving as a source of supporting or disconfirming evidence.

Qualitative Data Analysis

Our analysis of interview data included four phases that included both open and closed coding (Strauss & Corbin, 1998). First, we closed coded all data for reference to the who, how, what, and why of interactions about instruction in general and mathematics instruction in particular. For example, we coded around shared professional experiences that facilitated interactions among school staff members, as well as the subject- and student-specific content of those interactions. These 'macro codes' served as our initial 'sensitizing concepts' designed to focus our analysis on our research questions, while at the same time remaining intentionally broad, to allow for themes to emerge from our interview data (Creswell, 2007; Miles & Huberman, 1994). For reliability purposes, the researchers coded one-third of the interviews to establish interrater reliability (Carey, Morgan, & Oxtoby, 1996). This process included coding one interview and meeting to discuss commonalties and discrepancies. The researchers then recoded the interview and again discussed differences. Once kappa coefficients (Fleiss, 1971, 1981) of .85 or greater were achieved, researchers coded four additional interviews. Kappa coefficients for these interviews ranged from .72 to .99.

Using the report feature of NVivo 9, we generated reports by school and by position (e.g., principal, teacher) for each code in Phase 1 in order to identify patterns. For the purpose of this paper, one pattern that emerged was the prominence of organizational routines and the PLC routine in particular regardless of school or the informant's position. Second, we closed coded the data for any references to the PLC routine, including any descriptions of the design, implementation, structure, and functions of the PLC and descriptions of whether and how PLC members worked with one another during and outside of the formal routine. Reports by school and position from this second phase of coding enabled us to identify patterns that were especially important for our research questions. Third, we open coded by school all data identified under the PLC code, identifying themes and patterns that are reported in our findings below.

At this stage, we also returned to the organizational theory literature (Lazega, 2001; Rowan, 1990) to help us interpret and refine some of the patterns we found, especially those related to bureaucratic and collegial arrangements. Fourth, we defined seven themes that were most prominent across school and position as codes for our final stage of coding. The seven codes were a) reports of learning from PLC participation; b) reports of influence on practice from PLC participation; c) substance of PLC interactions particular to student learning, mathematics, curriculum and teaching; d) collegial arrangements; e) bureaucratic arrangements; f) reference to expertise of participants; g) evidence of de-privatizing classroom practice. We closed coded the data around these themes in order to establish the prominence of these patterns overall as well as by school and informant's position.

Quantitative Data Analysis

Auburn Park structured its PLC routine at the grade level, with the intention of supporting ongoing collaboration between general education and special education teachers who taught the same grade. Using our surveys, along with administrative records provided by the district, we identified 98 unique PLCs nested within 14 elementary schools (one PLC in kindergarten through grade 6 in each school). These PLCs ranged in size from 1 to 5 teachers, with an average of 3.06 teachers per PLC, and a standard deviation of 0.95. To address our second research question, we explored the relevance of the PLC routine to teachers' mathematics instructional advice and information interactions by comparing the frequency of these interactions within and outside of PLCs.

Next, to explore the relationship between bureaucratic and collegial arrangements in Auburn Park, we examined the association between PLC membership and frequency of collegial ties. Relationships among social networks can be analyzed using a quadratic assignment procedure (QAP), and multiple regression QAP (MRQAP) can be used to analyze the effect of dyadic properties on tie formation (Dekker, Krackhardt, & Snijders, 2007; Krackhardt, 1988). Whereas ordinary least squares regression does not work well with social network data given the dependence of the observations, QAP can be used to regress a matrix on one or more matrices, and it randomly permutes rows and columns of the matrices to remove the dependency of the whole matrix on the other matrices. For our analysis, we regressed frequency of collegial ties on whether or not teachers were in the same PLC using *UCINET 6* (Borgatti, Everett, & Freeman, 2002). We included four additional variables as controls: math advice and information ties (to account for curriculum-related ties), same gender, same sex, and same school.

Findings

Although the PLC label has become ubiquitous, easily and effortlessly adopted by many to denote any and every sort of collaboration or teamwork, AP's district policymakers designed a PLC organizational routine that reflected the essential

PLC characteristics as outlined in the empirical literature (see Vescio *et al*., 2008). AP's PLC routine focused on grade level teams, with teachers mandated to collaborate weekly for 45 minutes, often with the participation or presence of subject-matter specialists (e.g., instructional coaches) and school principals. By specifying the substance for these ongoing weekly collaborations – one meeting each month devoted to student issues, English language arts or reading, and mathematics instruction, respectively – district officials designed the PLC to focus school staff interactions on instruction and its improvement. The topic for the fourth monthly meeting was left up to each PLC, but was also expected to address instruction. AP's design and deployment of the PLC thus captures how policymakers can purposefully design a routine that structures ongoing collaborations and reflective deliberations about teaching and learning, which prior research suggests are important characteristics of effective PLCs. Further, we theorize not only how bureaucratic and collegial structures co-existed, but worked in tandem, differently over time, in the performance of AP's PLC routine.

Our findings are organized this way: First, we examine *how* the PLC routine structured interactions among school staff. Second, we consider how bureaucratic and collegial structures worked in interaction in the performance of the PLC routine. Third, we consider how the performance of PLCs reportedly changed over time in response to school leaders' intentional diagnostic and strategic design.

From Ostensive Design to Performative Aspect: The PLC Routine in Practice

Infrastructure designs do not always materialize as planned in practice -- the ostensive aspect of an organizational routine is not a mirror image of the performative aspect (Feldman & Pentland, 2003). Still, AP's PLC routine was essential in structuring instructional advice and information interactions (building blocks for knowledge development) among school staff. Specifically, teachers participating in the same PLC were more likely to seek and provide advice about mathematics instruction with one another than with teachers outside of their PLC. Across all 14 AP schools, teachers reported that nearly all their daily

Table 1. Percent of Math Ties Within and Outside of PLCs by Frequency, 2013

	Daily	**Weekly**	**Monthly**	**A few times per year**
Within PLC	98.6% (213)	90.6% (164)	35.0% (7)	9.1% (1)
Outside of PLC	1.4% (3)	9.4% (17)	65.0% (13)	90.9% (10)
Total	100 (216)	100 (181)	100 (20)	100 (11)

χ^2 (3, N=428)=164.42, p=.000. *Note*: Percentages are column percentages; counts in parentheses. Based on survey responses of 251 general and special education teachers.

and weekly interactions about mathematics took place with colleagues within their PLC (see Table 1). Ninety-nine percent of the colleagues that teachers interacted with daily for advice about math were PLC colleagues, and almost all of the remaining within-PLC interactions occurred on a weekly basis. In contrast, the colleagues that teachers interacted with for advice monthly or a few times per year were almost never their PLC peers, suggesting that PLCs were central to teachers' mathematics instructional interactions.

Our analysis of interview data supports and extends these findings about the importance of the PLC routine in supporting teachers' interactions about mathematics instruction, offering insight into the nature and substance of these interactions. We show how the ostensive aspect of the PLC routine did structure its performance including the substance of what teachers talked about. *All* school staff interviewed across five schools identified, unprompted, the PLC as a primary site for working with colleagues. Rebecca, a grade 5 teacher at Chavez summarized this point when, asked about her interactions about instruction, she informed us that the PLC routine was very important. All our interviewees spoke consistently about how their interactions in PLCs focused on curriculum and teaching. This happened as teachers worked together on long-term and short-term instructional planning. Carmen, an Ashton grade 5 teacher, explained that she and her PLC colleagues, "sat down and took the [state assessment test] table of specifications and we, all the standards that are going to be assessed, and we tried to match them up, like where in our curriculum do we teach this concept to see if we could find any holes or things that our curriculum doesn't focus on that we also need to make sure we talk about with our kids." Carmen captured how teachers in her PLC figured out together where particular topics in the state standards and assessments were covered in AP's curriculum so as to identify concepts that they might need to address in their teaching.

School staff also spoke about planning for teaching instructional units together. Becky, a grade 4 teacher at Chamberlin, remarked about her PLC team: "We plan once a week. When the unit begins we'll look at our long-term plan and where do we need to go and how long do we have. But then weekly we'll go through the day-by-day stuff." Carol, a grade 1 teacher at Bryant noted, "We plan all of our things together," going on to elaborate that, "Just before each unit we sit down and we talk about what are the objectives, what do the students have to learn, what activities can we do to ensure this… so we can ensure success of all the students and they're able to understand that." Carol captured how planning in the PLC went beyond what topics to teach, and engaged with what students needed to learn and what instructional approaches might work. Indeed, teachers' accounts suggested that PLC deliberations were an important opportunity for learning about teaching the prescribed curriculum.

Brenda, a kindergarten teacher at Ashton, spoke about an instructional strategy that "worked really well" for a colleague: "then I try it in my room. And it tends to work…or even when we're talking about things that aren't working and coming up with a new way to try." Brenda reported not only gleaning instructional

approaches from interactions with PLC colleagues, but also working with them to develop new instructional strategies. Mandy, a preschool teacher at Bryant, captured a prevalent pattern among teachers in our study, noting, "I always leave there [PLC] with some new idea or something that I want to implement, at least one." Seventy-nine percent of those interviewed recounted learning from their PLC interactions, and 70% reported changing their instructional practice in response to PLC interactions.

PLC deliberations went beyond acquiring or developing new instructional strategies to also focus on the underlying rationale for instructional activities. AP teachers were implementing a new inquiry-based mathematics curriculum, *Investigations*, and the PLC routine provided an opportunity to make sense of this curriculum. Andrea, a grade 3 teacher at Ashton explained, "It's just so different [*Investigations*], the investigating part of it. You know, just trying to make sure, 'Golly, tell me again, what's the purpose of this?'…Some of them don't really kind of make sense to me." Similarly, Becky a grade 4 teacher at Chamberlin noted with respect to PLC deliberations, "just a question about why, why are we doing this? You know why does this fit in and can you explain this? It's a method for adding…. You know usually in Investigations they give you lots of different methods to add up a problem and it was one of them that I was not exactly sure on." Similar to other teachers we interviewed, Becky's account captured how PLC interactions enabled teachers to make sense of the rationale behind the instructional activities in a new curriculum they were implementing.

Students and students' work also featured prominently in teachers' PLC deliberations, contributing further to de-privatizing instruction. Carmen, a grade 5 teacher at Ashton explained that PLC interactions helped her with grading her students' mathematics work, "helping me think through, 'Is this an appropriate response for a fifth grader?' Sometimes I think it's not, but she'll point out, 'But they did this and this' and I'll have not thought about that. Like, 'They did this good,' or 'They used this vocabulary well' or, so pretty typical and just helping me analyze student responses and just show understanding." She went on to note, "One of the other big things besides seeing if students have showed their understanding is how well is my instruction matching the end goal because we always talk about planning with the end in mind, so not teaching to the test but knowing what the concepts are on the test, how do I … teach to make sure they get that." Indeed, almost all teachers spoke about scoring students' assessments together during PLC meetings. Karen, a grade 1 teacher at Chavez, captured this when she noted, "'How would you score [grade] this?' And we've shared, without saying who, whose paper it was…what would you call this as far as our assessment scale, would you call this advanced, proficient, progressing or beginning…read through them together and see; we do a lot of double scoring…we do a lot of that at PLC's." Similarly, Jessica, a grade 2 teacher at Chamberlain reported, "We discuss what we're going to do. Anything extra that we think is maybe needed to help our kids from the holes that they might be missing or something."

Sometimes these interactions focused on understanding particular mathematical concepts and how best to represent these concepts to students. Andrea, a grade 3 teacher at Ashton remarked, "I know this one's coming up on distribution, I'm thinking, what? I never heard of that in teaching math before, but I'm thinking, what do they mean by that? So, it's now I have to go digging [check], you know, and I have to learn about it too…so that'll come up at this week's [PLC] meeting. But when we were doing mode, mean, those kinds of things with third graders, how do you explain that to them?" Andrea's comments suggest that interactions in PLCs went beyond exchanging information about curriculum and instructional strategies to developing mathematical understanding and figuring out how to represent mathematical ideas to students. Similarly, Becky, a grade 4 teacher at Chamberlin, noted, "I feel like I understand math a lot more…being able to help me figure out 'ok, well we have all of these different methods for adding up a problem or doing multiplication. Why are we doing them?' And then you know she just kind of helps me see 'oh yeah, this one works really well for this kid- for a kid that thinks like this'. Or you know when you're doing doubles and halves in multiplication how can that help out you know one of your really low kids?"

According to these accounts, PLC interactions made instruction public, de-privatizing it, as teachers shared and discussed their instructional strategies, worked to develop new ones, and scored and discussed their students' work. These accounts also captured the unpredictable and knowledge-intensive nature of the work of these teachers as they worked to make sense of and figure out how instructional activities and disciplinary concepts mandated in curriculum and state assessments might be operationalized for the classroom, how to tailor them to particular students' needs, and how to redesign them when they failed to work.

Teachers also reported how their learning about instruction through their PLCs extended beyond their weekly forty-five minute formal meetings to involve informal exchanges with their PLC colleagues. As Carol, a grade 1 teacher at Bryant put it, "We do that as we plan, but yet we're always constantly, we, on a day-to-day basis I feel like we almost talk, 'How did that go in math?' or, 'I did this and this worked great.' And so we're always just sharing ideas." Similarly, Rachel, a kindergarten teacher at Chamberlain noted, "A lot of times it's like after school or like if we're eating lunch we'll talk about, 'This is what I did yesterday. It worked really good,' or 'It didn't work really good.'" These accounts capture how the bureaucratically mandated and structured weekly 45 minute PLC routine performances enabled and informed regular informal interactions among PLC members.

Bureaucratic and Collegial Arrangements Working in Tandem in PLC Routine Performance

Based on our analysis, we argue that bureaucratic and collegial arrangements worked in tandem in the performance of the PLC routine. Bureaucratic arrangements were evident as district leaders required -- and school principals insisted

and monitored -- that teachers participate in the PLC routine weekly. Teachers were aware of these bureaucratic arrangements. As Loretta, a grade 2 teacher at Chamberlain put it, "PLCs are required weekly; grade level meetings are just when my team decides." Similarly, Katie, a grade 6 teacher at Chavez, noted, "We get a weekly plan from our principal and she tells us whether we're talking about assessments that week, or whether we're talking about curriculum." Evelyn, a special education teacher at Kingsley, was more direct: "It's been in a way mandated [by the school district]. It's kind of been like, 'You will work as a team whether you want to or not. This is your team so figure it out.'"

Still, this bureaucratic arrangement worked *interdependently with a collegial arrangement*. Eloise, a principal at Ashton, captured the interaction: "There are agendas set [for the PLC], that list right there. It's mapped out per week and then as a [PLC] team they determine what to talk with, like double scoring, what are they going to double score.[1] They're responsible as a grade level team for inviting a specialist…math or literacy facilitator, counselor, whatever adult they think would be helpful in their brainstorming session…their input is just critical." From Eloise's perspective, bureaucratic authority mandated weekly meetings and the topics, whereas the PLC team was able to determine the particulars of the work on that topic and decided as 'a grade level team' what experts to invite.

School leaders' and teachers' accounts consistently underscored the importance of collegial structure to their PLC work, with 29 of the 33 interviewees (88%) making direct reference to collaborating with PLC colleagues. Our quantitative analysis also revealed the significant and positive association between being in the same PLC and having a frequent collegial tie, controlling for homophily variables (same gender and same sex) and curriculum-based ties (see Table 2). That is, even after accounting for whether or not teachers interacted about the content around which many of their PLC meetings were focused (i.e., curriculum, teaching, and student learning in mathematics), teachers interacted with their close colleagues with significantly greater frequency when those colleagues were members of their PLCs.

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1   Double scoring occurs as teachers examine student assessment data. Two teachers score the same student assessment and discuss their results during the PLC in order to come to an agreement around the assigned rating or grade.

*Table 2. Parameters for an MRQAP Model Predicting
Frequency of Close Colleague Ties, 2013*

	Standardized Coefficient
Same PLC	0.203*** (0.010)
Math Tie	-0.098*** (0.008)
Same Race	-0.103** (0.022)
Same Gender	-0.127*** (0.012)
Same School	1.056*** (0.067)
Intercept	-0.004*** (0.001)
R2	0.825
n	[251]

*** = p < .001; ** = p< .001

Notes: Standard errors in parentheses. Results are based on 2000 permutations and a random seed of 214.

Andrea, a grade 3 teacher at Ashton, captured the collaborative and consensus-like nature of those PLC exchanges, remarking, "We work really well together. I mean we're all open to suggestions and when you're sinking and you're thinking, what else can I do? You know, somebody comes up with you know, try this." Andrea captured the egalitarian nature of the PLC in practice with colleagues being 'open to suggestions' and working 'well together'. Though hierarchical authority mandated PLC participation and discussion topics, it was not the basis of authority in the actual PLC performance. Brenda, a kindergarten teacher at Ashton, stated: "Leading the [PLC] meeting kind of depends on what the theme for it is; when I'm talking about my kids, I lead the meeting and then everybody kind of pipes in and we work on things that could help with them… we all put in our two cents worth [input] so whether it is double scoring or talking about other kids, we all put in our ideas and then kind of come together; it's a collaborative effort." For Brenda, like most others, PLC deliberations were characterized by egalitarianism and consensus, with authority dependent on whoever had the expertise for the topic under consideration.

Similarly, Jessica, a grade 2 teacher at Chamberlain, captured the distributed nature of PLC leadership, depending on who had the necessary expertise: "I

don't know who, if we really have a leader per se. I don't know if it's Katie or me. I'm not sure which one it is. Maybe we share it. I'm thinking that's what we do. She does what she does well at, I do what I do well at." John, a grade 2 teacher at Chavez, remarked, "We all have our strengths [i.e., expertise] and so Betty is really good at teaching writing and so a lot of the things that she does in writing I've brought in my own room…. I use her as a model in that area." Here, John and Jessica describe how the leadership role in PLCs is not embedded in any one person, but is stretched across multiple individuals, a key aspect of distributed leadership (Spillane, 2006).

School principals attended PLC meetings frequently, but they reported not leading them, instead contributing based on their expertise rather than their positional authority. For example, Jillian, the principal at Bryant, noted: "My goal is to be at every PLC…. I would say I'm a team member, hopefully I'm another resource, another opinion for when we're looking at curriculum, to help guide them, and am definitely not the leader of the PLC." Jim, the principal at Kingsley, stated, "I have a very low profile in the PLC meetings. I purposely sit in the corner." Principals reported putting aside their positional authority at PLC meetings so that authority was a function of expertise and consensus. Teachers confirmed this in interviews. As Tracy, a special education teacher at Ashton, explained, while the principal frequently attends PLC meetings she is not always leading them by exercising the formal bureaucratic authority of her position: "The principal is usually at those meetings, but not necessarily leading those meetings."

Overall, staff who had worked in the district since before the implementation of PLCs spoke about a changed work life with the PLC implementation. Andrea, a grade 3 teacher at Ashton, remarked, "Years ago we just, you were on your own. And now everybody's willing to share ideas and strategies and materials. Now it's a discussion of how things should look and what, what can you bring to it?" Likewise, Joanne, a grade 6 teacher at Bryant, noted, "I think if anything it's becoming more team-oriented and more sharing oriented, going that way more than just a teacher in the room themselves doing what they want to do." Mandy, a grade 2 teacher at Bryant said, "Before our math instruction was kind of basically teacher driven, just myself." Georgia, the principal at Bryant remembered, "They [teachers] were all over the place, there's no consistency…they certainly didn't talk to each other as much as a grade level…they tended to operate in cliques." These accounts capture school leaders' and teachers' assessment of how the PLC routine transformed their daily work lives. These accounts also document how teachers worked in a cottage industry, mostly in isolation rather than collectively on matters of instruction, in the past.

The Interaction of Bureaucratic and Collegial Structures Over Time

The interaction of bureaucratic and collegial structures in the PLC routine varied within schools and over time. School leaders openly acknowledged that some aspects of the PLCs routine functioned more cohesively and collaboratively

than others within their schools. Our quantitative analysis confirmed this, finding that the variation in density of PLC interactions was much greater within schools than between schools (91% compared to 9%, respectively). School leaders also reported using their formal bureaucratic authority differently, depending on how the particular PLC was working, in an effort to improve its performance. Although cross sectional interview data is limited in capturing longitudinal changes in practice, the data is suggestive. For example, Georgia, the principal at Bryant explained that, "In the beginning we were very tightly managed, that 'I want you to talk about kids at this time', 'I want double scoring' and all of that, and so it was more tightly managed in the beginning when we first started to more loosely as teachers started taking control of their own groups. I attended as frequently as I could…trying to get the groups to be more data driven, be more diagnostic… 'Georgia' can't read. Well why can't 'Georgia' read? What do I know about 'Georgia' as a reader?'…and so trying to have those kinds of conversations." These suggest that school leaders used their bureaucratic authority at the outset to ensure that the PLC routine worked in ways that were consistent with its intent – ostensive aspect.

When the PLC routine was introduced at Bryant, a bureaucratic structure dominated, as school leaders struggled to get PLCs working in ways that would enable professional learning. Indeed, Georgia explained that Bryant studied their PLCs in practice using "surveys" and "observations" as well as an outside consultant to "observe our teams and give us feedback." According to Georgia, "in the beginning it was embarrassing" for teachers at Bryant who did not "want to brag…when you ask them to start sharing ideas, but over time it opened up, people were much more willing." Georgia explained that the school's leadership team used this research "to guide … [and] tighten" the PLCs at Bryant, and over time a collegial structure took prominence in the workings of Bryant's PLCs. These accounts also suggest some initial reluctance if not resistance on the part of teachers to participating in the PLC routine and the application of bureaucratic control on the principal's part to overcome this reluctance.

Similarly, Mary Beth, the principal at Chavez, described her experience: "Over the years it's changed as we first moved into the [PLC] process I was a lot more involved as far as setting up what they would talk about, leading the discussions, providing them things to read as we learned…what and how a PLC effectively works. And the teams, their capacity to work as purposeful teams has really grown over time so they develop their own agendas…it's left up to them. They have ownership." Likewise, Jim, the principal at Kingsley, noted how when he started as principal the PLC "was in place but I frankly felt it was very loose and very weak. So a lot of it was you know creating a structured schedule and laying out some expectations." Jim thus had a strategy for developing PLCs at Kingsley: "My strategy has tended to be that I have so-called pockets of leadership around the building, ideally at least somebody in every team that would have the ability to answer questions of staff." In these accounts, what is striking is the diagnostic work and the design work school leaders did

in order to improve the performance of the PLC routine over time. As Jim put it, "It's sort of strategic, you're sort of looking at it like a big puzzle piece or a chess game…a strategy for arranging people a certain way. You know that old adage 'get the right people on the bus' but then the next part is to make sure you have them in the right seats on the bus." These accounts show how school principals used their bureaucratic control selectively to introduce changes that they believe essential to ensuring the performance of the PLC routine in their schools were consistent with its design intent (i.e., ostensive aspect) to promote interactions among teachers about instruction that enabled their learning from and about instruction.

As evident in these school leaders' remarks, this diagnostic and design work extended beyond the PLC to the broader school and system instructional guidance infrastructure, including organizational routines (e.g., teacher hiring), formal positions, and the district-wide curriculum, all of which were key to understanding the PLC in practice. Jim captured the extensiveness of the diagnosis and design work when he noted, "It is about the hiring process, trying to look at the people you have and… some of it has to do with moving people to different [PLCs]. Some cases it's growing the right people. So you kinda have to look at all those strategies. It's trying to combine hiring with mentoring, growing new people and so on." The PLC organizational routine was one component of a more elaborate and reasonably specified instructional guidance infrastructure, and improving the PLC routine required diagnostic and design work that included other organizational routines, formal positions, and curricula. To understand the workings of a single organizational routine such as the PLC, independent of the broader infrastructure of which it is part, is difficult.

Discussion and Conclusion

Empirically, our analysis captures how the design and deployment of a PLC organizational routine school system-wide structured interactions about mathematics instruction among school staff. The PLC routine was central to teachers' interactions about mathematics instruction: The colleagues that teachers interacted with daily for advice about math participated in the same PLC routine, whereas the colleagues that teachers interacted with for advice monthly or a few times per year were almost never their PLC peers. Even more striking was the substance of these interactions, which according to those interviewed pushed beyond simple planning to identify the underlying rationales and philosophies for curricular and instructional decisions, and which promoted norms of de-privatized instructional practice and transparency on matters of instruction.

It is important to remember that the PLC routine in our study was just one component of the school district's redesigned instructional guidance infrastructure (IGI) for mathematics and it worked in interaction with other IGI components including a new mathematics curriculum to structure teachers' interactions about mathematics. Situating it as an organizational routine that worked interdependently with other components of the schools systems IGI for mathematics

is essential as the PLC routine did not operate and influence teachers' work in isolation *but rather in interaction* with these other components of the IGI.

Our particular framing of the PLC initiative in AP as a case of designing and deploying an organizational routine to transform organizational work practice makes several contributions. By framing AP's PLC initiative as an organizational routine, we show how empirical work on PLCs, if situated in the empirical and theoretical literature more broadly (e.g., organizational theory), can make a broader contribution to the empirical and theoretical knowledge base on transforming work in schools and organizations. By doing so, researchers that study educational reforms can benefit from an established empirical and theoretical knowledge base in framing their research. Specifically, our account documents how organizational routines (i.e., the PLC routine) -- often maligned for inhibiting change and contributing to inertia -- can be a source of tremendous change in school organizations and school systems. The PLC routine in AP structured, in some cases more easily than others, how teachers and school leaders interacted with one another about mathematics instruction. Further, the PLC routine enabled the transfer of advice and information among school staff about mathematics instruction. In addition, framing the PLC initiative as a case of the design and deployment of an organizational routine will enable conversations with other literatures such as the literature on Lesson Study, Instructional rounds, and Learning Walks that can also be framed and understood as organizational routines. Such conversations are essential to building a solid empirical knowledge base on designing school systems and schools for instructional improvement.

Theoretically, based on our analysis we argue that bureaucratic and collegial arrangements did not just co-exist, but actually worked in tandem in the design, deployment, and performance of the PLC routine in particular schools and grade levels at particular times. While we did find some evidence of reluctance (even resistance) to performing the PLC routine in schools, our analysis shows how bureaucratic and collegial arrangements worked together in getting the PLC implemented and institutionalized. In practice, PLC routines were bureaucratically mandated and monitored while also fundamentally collegial in performance. Based on our analysis we argue that this interaction of bureaucratic and collegial arrangements evolved in schools *over time* and *selectively* depending on the performance of the particular PLC. Specifically, school leaders employed bureaucratic control *selectively* depending on how particular PLC routines were being performed relative to the design intent. When particular grade levels were not performing the PLC as intended, school principals used bureaucratic control both directly (e.g., sitting in on PLCs and modeling appropriate practice) and indirectly (e.g., hiring staff and assigning them to particular grade levels) in an effort to improve performance so that it better reflected the design intent (i.e., ostensive aspect). And, when PLCs were performing as intended, school leaders reduced bureaucratic oversight. Both bureaucratic and collegial arrangements

then worked interdependently in the design, deployment and practice of the PLC routine.

By framing PLCs, at least as designed and deployed in AP, as organizational routines particular category of school reform initiatives that includes other reforms (e.g., Lesson Study, Instructional Rounds, Teacher Video Clubs, and Learning Walks) we argue that scholars who study these various initiatives --often in sub-fields within education and rarely speaking to one another -- might benefit by situating their particular studies as cases of something broader and learn from interacting with one another. In doing so they would also benefit from the accumulated wisdom of a much broader theoretical and empirical knowledge base. Of course, depending on the particular PLC initiative under study and how it is designed and deployed, the organizational routines framing may be more or less appropriate.

More broadly, our account offers additional evidence of an outcome of the standards and accountability movement that has gone mostly undocumented in education research: Local school systems and schools redesigning their educational infrastructures to enable a particular approach to mathematics instruction as well as support for improving mathematics instruction in ways that are consistent with this approach. While our study is based on a single school district and its 14 elementary schools, it does offer more evidence that an untold outcome of the standards and accountability movement of the last quarter century or more in the US has been to prod local school systems to redesign or design their educational infrastructures to support instruction and its improvement. Our conclusion here in no way undermines other empirical work that documents both positive and negative outcomes from the standards and accountability movement in terms of classroom teaching practice and student achievement. Still, our analysis contributes to a small but expanding literature on how the standards and accountability movement has prompted local school systems to design and redesign their instructional guidance infrastructures to support instruction, maintain instructional quality, and lead instructional improvement. It is also of note that the state in which our study was conducted was the last state in the US to introduce state standards tied to assessments. So while district and school leaders in our study were cognizant of shifts in their state policy environment, they were responding to the standards and accountability movement more broadly.

Our account informs educational policy and practice in at least two ways. First, our account captures how education research informs policy and infrastructure design, showing how bureaucratic authority can be strategically mobilized to support the design of organizational routines to structure school staff interactions, and to do so in ways that both in design and practice are roughly consistent with the research evidence. This contradicts the folklore that practitioners and policymakers mostly ignore research. Second, the education research enterprise is replete with either-or-narratives. Scholars, eager for media mentions, are ready and willing when in the limelight to cast their findings, intentionally

or not, as supporting one camp or another (Henig, 2008). Our analysis suggests that it is not a matter of either bureaucratic or collegial/professional authority, but, instead, that PLCs can indeed be designed and deployed through bureaucratic structures, while their workings depend not just on collegial structures but the interaction of both. Our account underscores the importance of eschewing simplistic either/or accounts about improving school systems and schools in favor of engaging the complexity of how education systems and school organizations work. Careful design work, melding bureaucratic and collegial structures differentially, can structure instructional interactions.

Like all research, our work has several limitations; chief among them is that we did not observe the performance of PLCs as they were being deployed over time in AP. Instead, our qualitative work relied mostly on retrospective accounts about the deployment of the PLC routine in AP, and retrospective accounts are plagued by problems of informants' recall. Future work on the design, deployment, and workings of PLC routines (and indeed other organizational routines designed to support school staff learning from and about instruction) would benefit from longitudinal designs that followed the implementation of the routine through in-depth observation and interviews. Such work, for example, would enable us to better understand how bureaucratic and collegial mechanisms worked in interaction (for good and bad) in the actual performance of PLC routines. Further, such work would enable a more fine-grained analysis of how the ostensive aspect of the PLC routine informed its performance in particular places at particular times, and whether and how the performative aspect of the PLC routine informed the ostensive aspect over time. Such work would not only generate useful and usable knowledge for schools interested in deploying PLCs but would also make an important contribution to the literature on the role of organizational routines in organizations.

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