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ARTICLE

Understanding the link between professional learning communities and teacher collective efficacy

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ABSTRACT

Research suggests effective professional learning communities (PLCs) enhance teacher collaboration and student achievement. Some studies indicate that these communities also predict greater collective efficacy, while others suggest teacher efficacy is predictive of teachers working together. Although studies have identified effective, research-based PLC practices, how these specific practices effect collective efficacy has not been thoroughly studied. This study, using structural equation modeling (SEM), investigated the relationship between PLCs and teachers' collective efficacy drawing on 310 surveys from 16 schools in 1 district that had systematically implemented PLCs. Our findings showed that higher functioning PLCs predict higher levels of teacher collective efficacy (TCE). This suggests that engaging and supporting teachers in PLC work, as this district did, can lead to enhanced collective efficacy, which in turn can contribute to improved student achievement.

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Professional learning communities; teacher collaboration; teacher teams; teacher collective efficacy; data use

Introduction

Countries around the globe are striving to improve student learning often through setting higher standards. Yet, many systems still struggle to consistently raise student achievement. As McLaughlin and Talbert prophetically reported in 1993, "At its core, the problem of systemic reform fundamentally is a problem of teachers learning how to translate enhanced curricula and higher standards into teaching and learning for all of their students" (p. 5). Increasing opportunities for teachers to work in professional communities has been advocated and studied as one approach to ensure needed teacher learning (DuFour & Eaker, 1998; Hord, 1997; Lieberman, 1995; Little, 1982; Louis & Marks, 1998; Rosenholtz, 1989; Timperley, 2008). McLaughlin and Talbert (1993) showed "that teachers' groups, professional communities variously defined, offer the most effective unit of intervention and powerful opportunity for reform" (p. 18). Based on their review of the literature, Stoll, Bolam, McMahon, Wallace, and Thomas (2006), suggest that, "developing professional learning communities appears to hold considerable promise for capacity building for sustainable improvement" (p. 221). As McLaughlin and Talbert (2006, 2010), Timperley (2008), and many others have pointed out, however professional communities are difficult to implement and sustain, are not a panacea, and may not lead to improved student learning or achievement.

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A companion construct that research has identified as critical to improved student outcomes is teacher collective efficacy – the shared beliefs of teachers within a school that they can collectively, significantly, and positively influence student learning. Without a shared sense that they can make a difference and achieve desired goals, professional learning communities are unlikely to set challenging goals, look at student work in ways that delve into teacher practices, or invest in new ways of teaching. Studies by several scholars have shown that higher levels of teacher collective efficacy are associated with and predictive of increased student learning (Bandura, 1997; Goddard & Goddard, 2001; Goddard, Goddard, Kim, & Miller, 2015; Goddard, Hoy, & Woolfolk Hoy, 2000, 2004; Moolenaar, Sleegers, & Daly, 2012).

The significance of both professional learning communities (PLCs) and teacher collective efficacy (TCE) has stimulated subsequent studies to explore the relationship between these two constructs. A few studies have suggested that teacher efficacy is predictive of greater teacher collaboration in teams or professional learning communities (Gray & Summers, 2015; Rosenholtz, 1989) whereas other studies indicate that teachers working together predict greater efficacy (Goddard et al., 2015; J.C. Lee, Zhang, & Yin, 2011; Moolenaar et al., 2012; Wahlstrom & Louis, 2008). The purpose of the current study is to further explore the direction of the relationship between professional learning communities and teacher collective efficacy using structural equation modeling (SEM). In this study, teachers at each school completed surveys about their perspectives of their team's PLC work and teacher collective efficacy. To understand the relationship between PLCs and TCE, data were aggregated to the school and then district level. Individual teams were not the focus of this SEM study.

Deepening understanding of the relationship between these two constructs has implications for practice by providing guidance for administrators in knowing where to focus their first efforts: building team relations, teacher confidence, and positive regard or engaging teachers in actual collaborative data analysis and lesson planning work. This study also contributes to the field because the data are drawn from a district that chose to systematically involve all schools in implementing a PLC model. All teams within each school were provided regular release time for grade level (elementary), interdisciplinary (middle school), or departments (high school) to meet. Team leaders were provided professional development in a PLC process (DuFour & Eaker, 1998) in how to guide their team in analyzing student data and work, developing common assessments, and refining instructional practices to improve learning. This approach represents a systemic approach that scholars (e.g., Timperley et al., 2009) have urged is essential to schoolwide improvement. At the time of the study, the district was in its 5th year of implementation and experiencing significant and sustained student achievement in all schools. Thus, it serves as an informative case for exploring the PLC/collective efficacy relationship and identifying which PLC variables are most significant in promoting collective efficacy.

Literature review and conceptual model

Professional learning communities

There is no universal agreed-on definition of professional learning communities (Lomos, Hofman, & Bosker, 2011), and a variety of labels are found in the literature such as *teachers' collaboration with colleagues* (Rosenholtz, 1989), *professional community* (Little, 2003; Louis,

Kruse, & Marks, 1996), *professional learning communities* (cf. Bolam, McMahon, Stoll, Thomas, & Wallace, 2005; DuFour, DuFour, & Eaker, 2008; Hord, 1997), *communities of practice* (Wenger, 1998), *collegial inquiry communities* (Timperley, 2008), and *purposeful communities* (Marzano, Waters, & McNulty, 2005). Each of these descriptors, depending on their author's research and experience, often have a slightly different focus. Most scholars, however, agree that teachers examining their practice to improve student learning is central (Stoll et al., 2006). One definition offered by Timperley et al. (2009) is "groups of individuals who collaborate to advance their professional knowledge and skills to achieve valued outcomes. The purpose of the community is to learn from each other to achieve these outcomes" (p. 21). De Neve, Devos, and Tuytens (2015) define PLCs as: "a school organization in which a group of teachers share and question their practice from a critical point of view. This questioning happens in an ongoing, reflective, collaborative, and inclusive way" (p. 32). We use this definition because it captures succinctly the nature of the work of the PLC teams in this case district. We use the term PLC for reading ease and to reflect the model of reform implemented.

Research supporting the benefits of PLCs

Professional communities have been incorporated into many reform efforts (Duke, 2006; Hord & Rutherford, 1998) because a growing body of research suggests they facilitate teachers developing new skills and strengthening their pedagogy (Bryk, Camburn, & Louis, 1999; Louis & Marks, 1998; McLaughlin & Talbert, 1993; Scribner, Cockrell, Cockrell, & Valentine, 1999; Smylie & Wenzel, 2003; Wahlstrom & Louis, 2008), which in turn influence and enhance students' learning (Berry, Johnson, & Montgomery, 2005; Bolam et al., 2005; Hollins, McIntyre, DeBose, Hollins, & Towner, 2004; J.C. Lee et al., 2011; Louis & Marks, 1998; Newmann & Wehlage, 1995; Pancucci, 2008; Tighe, Wang, & Foley, 2002; Wiley, 2001). Phillips (2003) reported that student achievement scores increased dramatically over a 3-year period in a middle school's ratings on a state-wide standardized test where scores increased from 50% of the students passing reading, writing, math, science, and social studies to over 90% of students passing each subject area test (p. 256). Vescio, Ross, and Adams (2008) reviewed 11 studies that focused on the impact of PLCs and concluded that well-developed PLCs have a positive impact on both teaching practices and student achievement. A meta-analysis of professional community research found PLCs had a medium effect on student achievement (Lomos et al., 2011). Hughes and Kritsonis (2007) study of 64 schools in Texas also showed that over a 3-year period, 90.6% of the PLC schools achieved higher standardized math test scores with 42.3% increasing by more than 5 percentile points. A study by Moolenaar et al. (2012), using Social Network Analysis, showed that the density or closeness of teachers working together did not have a direct effect on student language arts achievement, rather the effect was mediated by teacher collective efficacy. Goddard et al. (2015) also found that the effect of PLCs on student achievement was mediated by collective efficacy. The nature of the teachers' team work in these two studies was left unspecified.

One explanation for the improved student learning is that PLCs enhanced teacher learning (Andrews & Lewis, 2007; Bolam et al., 2005; Moolenaar et al., 2012). A multi-school study conducted by McLaughlin and Talbert (1993) confirmed Rosenholtz's (1989) findings that teachers gained shared knowledge when they were given opportunities to work together. Darling-Hammond (1996) and, more recently, Lomos et al. (2011) found that when teachers engaged in collaborative inquiry, their knowledge was enhanced

and they experienced greater shared understanding. Hord's (1997) data revealed that working within a PLC impacted teachers' educational practice particularly on professionalization processes and planning and implementing high-quality lessons. Similarly, Kelchtermans' study (Kelchtermans, 2006) confirmed that teachers working in teams led to collectively designed high-quality lessons. Certain characteristics of PLCs, however, seem to yield this greater knowledge and understanding.

Defining PLC variables

Several authors, through survey research of teachers' perceptions of how they worked together, the nature of the collective work, and the conditions that supported the work, have identified key PLC variables (Hord, 1997; Louis et al., 1996; Taylor, Pressley, & Pearson, 2000; and the practice-oriented work of DuFour et al., 2008). Although there are many similarities, there are some differences based on the research perspectives of the authors. The common practices identified were (a) shared vision and values, (b) a focus on student learning, (c) collaboration and collective action, and (d) sharing practice and helping each other. Louis and her colleagues (1996) explicitly focus on deprivatizing practice through observations of each other's classroom; whereas DuFour and Eaker (1998) mention the characteristic of teachers collectively experimenting with an approach or practice and then meeting to share results and determine if the experiment improves student learning. Monitoring student progress and focus on results through data analysis are explicitly identified in the Taylor et al. and DuFour and Eaker list of characteristics. In Taylor et al. (2000) meta-analysis of five studies of moderate to high-poverty elementary schools with increased achievement, reaching out to families for support was identified. They concluded that the PLC model served to offset economic and other factors that put students at risk for failure through empowering teachers in working together to help all students succeed in school. The work of Hord (1997) with the Southwest Educational Development Laboratory (SEDL) identified two unique variables: (a) shared and supportive leadership and (b) supportive conditions, such as time to meet during the school day. In our study, the three variables (relations with parents, leadership, and supportive conditions) were not addressed. Because the study district implemented the DuFour and Eaker PLC model, this study focused on assessing the PLC variables identified in their work, which included: shared mission, vision, values, and goals; collective inquiry into "best practices" and "current reality"; collaborative teams focused on learning; action orientation and experimentation; commitment to continuous improvement; and results orientation.

Self- and collective teacher efficacy

Teacher self-efficacy as a factor in school improvement has been of interest for many years, particularly as influenced by work of Rotter (1966) and Bandura (1977). Teacher efficacy has been defined as "the extent to which the teacher believes he or she has the capacity to affect student performance" (Berman, McLaughlin, Bass-Golod, Pauly, & Zellman, 1977, p. 137). While it is beyond the scope of this study to review all the literature on teacher self-efficacy (see Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998), it is important to note that teacher self-efficacy has been linked to improved student achievement (Ashton & Webb, 1986; Berman et al., 1977).

Collective efficacy is a relatively new concept in the educational literature with properties analogous to teacher self-efficacy (Goddard & Goddard, 2001; Goddard et al., 2004). Collective efficacy refers to the beliefs that organizational members hold about their work groups' capability to organize and execute a plan of action necessary to reach desired goals, that is, enhanced student learning and performance (Goddard et al., 2004; Goddard & Skrla, 2006). Goddard et al. (2004) stated,

> collective efficacy beliefs are far more strongly related to teachers' perceptions of self and group capability to achieve common goals than many more common measures of school context. Moreover, these findings also suggest that collective efficacy beliefs may influence student achievement indirectly through their relationship with teachers' sense of efficacy (p. 9).

Goddard and Skrla (2006) assert that the stronger an organization's collective efficacy beliefs, the more organizational members will put forth the sustained effort and persistence necessary to reach the goals. These findings suggest that high collective efficacy will be predictive of better functioning PLCs. In their work, Goddard and Goddard (2001) found that sources of collective efficacy beliefs were from the same four sources associated with teachers' sense of self-efficacy (Mastery Experience, Vicarious Experience, Social Persuasion, and Affective {Emotional} State). Goddard et al. (2000), however, also showed that teacher collective efficacy has two additional factors: analysis of the teaching task, especially in working with students in challenging circumstances, and assessment of teaching competence. Analysis of teaching task represents teachers' perceptions that they have the structures, processes, and strategies needed to succeed with all students and believe they can work with all students regardless of student background, family life, and environment. Teaching competence is teachers' perceptions that other members in their group have the necessary skills to successfully complete the task. In our study, we focus only on these two variables of teacher collective efficacy, which they labeled Analysis of the Teaching Task (Task Analysis) and Assessment of Teaching Competence (Group Competence).

Professional learning community and efficacy

Several studies have more explicitly explored teacher collaboration and/or professional learning communities and efficacy (Goddard et al., 2015; Gray & Summers, 2015; Kennedy & Smith, 2013; V.E. Lee, Dedrick, & Smith, 1991; J.C. Lee et al., 2011; Moolenaar et al., 2012; Newmann, Rutter, & Smith, 1989; Rosenholtz, 1989). The studies differed, however, in whether they focused on teacher self- or collective efficacy. They also varied in the clarity with which they defined how teachers worked together and the scope of the study, with some looking at school-context variables as well as collaboration and efficacy. Rosenholtz (1989), for example, conducted a mixed-methods study that involved 78 elementary schools and 1,213 teachers in Tennessee. She found that when teachers worked together in a collaborative culture and celebrated their successes, teachers' sense of self-efficacy contributed significantly to gains in student learning in reading and math over a 2-year period. Rosenholtz concluded that "teachers' efficacy … is one of the most powerful predictors of collaboration" (p. 46).

Newmann et al. (1989), in their study of 353 public high schools with data from principals and over 10,000 high school teachers, also explored several organizational factors and their effect on teacher self-efficacy, teacher community, and expectations.

They defined teacher self-efficacy as teachers' perceptions that teaching is worth the effort, leads to student success, and is personally satisfying. A sense of community "conveys a relationship of unity, belonging, and cooperative interdependence among peers" (p. 223). They found the most powerful organizational effects on efficacy, teacher community, and expectations were: (a) students' orderly behavior, (b) the encouragement of innovation, (c) teachers' knowledge of one another's courses, (d) the responsiveness of administrators, and (e) teachers' helping each other (collaboration). They concluded that there was a strong relationship between teacher community and self-efficacy. However, the direction of the relationship between self-efficacy and community was not studied, nor did they explore specific factors of teacher collaboration.

V.E. Lee et al. (1991) also examined links between teacher self-efficacy and school organizational factors in secondary schools. They sampled over 8,400 teachers in public and Catholic high schools. The elements they found influencing efficacy included: (a) principal leadership, (b) communal school organization, (c) orderly environment, and (d) teacher control. The researchers found that the strongest predictor of teacher efficacy is communal organization in which teachers shared beliefs and values, developed supportive relationships, and felt respected and accepted. Thus, in contrast to Rosenholtz (1989), they suggested a collaborative culture is predictive or essential to the development of teachers' sense of efficacy.

As the terms professional community, professional learning communities, and collective efficacy came to the fore, more recent studies have explicitly addressed these concepts. Wahlstrom and Louis (2008) explored the roles of professional communities and self-efficacy. Their quantitative study included 4,165 kindergarten through 12th grade (K–12) teacher participants in 39 districts in 138 schools. Using stepwise linear regression models, they found that self-efficacy strongly predicted "Focused Instruction".

Gray and Summers (2015) conducted a quantitative study exploring PLCs, school structures, trust, and teacher collective efficacy. Based on their analysis of survey data from 193 teachers in international schools using an American curriculum in Central and South America, they found that the more established the school enabling structures, trust in principal, and collective efficacy, the more likely schools developed PLCs. In contrast, J.C. Lee et al. (2011), who also explored the predictive nature of PLCs on teacher collective efficacy, reached the opposite conclusion. They found, using hierarchical linear modeling (HLM) analysis of 660 teacher surveys from 33 schools in Hong Kong, that PLCs had a positive statistically significant effect on teachers' collective efficacy.

Goddard et al. (2015) investigated the more general construct of teacher collaboration and collective efficacy in support of student learning. Their quantitative study included 1,606 teacher participants from 93 elementary schools that served rural, high-poverty students. Using multilevel SEM, they found that teacher collaboration was a significant predictor of collective efficacy, which in turn positively predicted gains in achievement ($\beta = .27$ for math; $\beta = .28$ for reading). The researchers acknowledged that they use a broad definition of teacher collaboration and urged future researchers to address more specific elements of collaboration.

Moolenaar et al. (2012), in a study of 52 Dutch elementary schools, explored two key aspects of teacher collaboration (the density or closeness with which teachers worked and centrality of a teacher leader in a cluster of teachers) and their effect on collective

efficacy and student outcomes. Their study showed that density did not have a significant direct effect on student outcomes, but had a statistically significant effect on teacher collective efficacy, which in turn directly affected student outcomes in language arts. Specific collaborative actions that might contribute to collective efficacy were not investigated. Kennedy and Smith (2013) study explored five key variables of collaboration identified in other PLC studies and their effect on the internal and external physiological dimension of teacher self-efficacy. The collaborative variables were collective peer relations, collective learning, reflective practice, leadership/vision, and decision-making. Collective reflective practice was the only variable that led to enhanced external physiological self-efficacy (i.e., teachers comfort in looking at data, sharing ideas with colleagues, being observed, and participating in professional development). Teachers' perception that the school culture supported collective learning and decision-making were the only variables that showed increased teacher comfort in internal physiological self-efficacy (i.e., feeling comfortable with their own instructional and disciplinary practices and working with parents).

These studies are important and relevant because they add to the body of literature confirming a correlation between PLCs and teacher efficacy, with some focusing on teacher self-efficacy and others on collective efficacy. Interestingly, some studies showed that teacher efficacy was predictive of enhanced teacher collaboration (Goddard & Skrla, 2006; Gray & Summers, 2015; Rosenholtz, 1989), while others indicated that the presence of PLC or a collaborative culture predicted enhanced teacher efficacy (Goddard et al., 2015; J.C. Lee et al., 2011; V.E. Lee et al., 1991; Moolenaar et al., 2012). The current study contributes to this literature using SEM to further explore the direction of the relationship between PLC and teacher collective efficacy variables in a US context. An important finding of the Goddard and Goddard (2001) and the Moolenaar et al. (2012) studies was that collective efficacy is a predictor of increased student achievement. This study builds on their work by focusing on collective efficacy as opposed to teacher self-efficacy and adds by investigating which variables of a school's PLC work may best predict increases in collective efficacy.

Conceptual model

We highlighted in our literature review some of the strongest evidence regarding variables of professional learning communities. For purposes of this study, we focus on three PLC variables that emerged from the factor analysis: Collective/Shared Goals, Collective Actions, and Focus on Results. We also assessed the two factors that Goddard (2002) determined to be critical components of collective efficacy: assessment of teaching competence (Group Competence) and teacher perceptions of their efficacy in addressing needs of students in challenging circumstances, called Task Analysis. Based on the literature review and the contrasting conclusions about the relationship between PLCs and teacher collective efficacy, we tested both relationships. This study validates the previous findings that well-functioning PLCs predict higher levels of teacher collective efficacy. Figure 1 presents the conceptual model, which suggests the paths by which the PLC factors of Collective Goals, Collective Actions, and Focus on Results effect teacher collective efficacy factors of Task Analysis and Group Competency. In this study, the outcome or dependent variables are collective efficacy characteristics. We indicate improved student learning in italics as the ultimate outcome

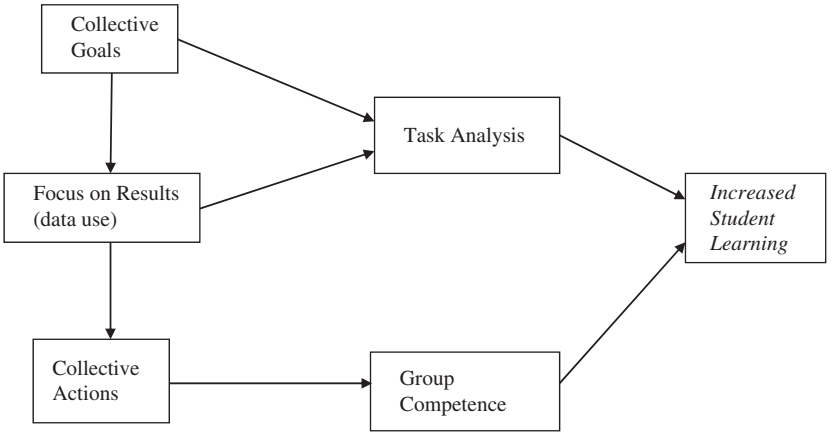

Figure 1. Conceptualized professional learning community depicting the relationships between professional learning community and collective efficacy.

since in the case district student achievement was increased dramatically over a 5-year timespan after implementing districtwide PLCs as its reform strategy.

This study used Pearson's *r* correlation and SEM analysis to address the overarching research question and hypotheses:

What is the relationship between variables measuring teacher collective efficacy and variables measuring PLC characteristics?

Hypothesis 1: There is a positive relationship between teacher collective efficacy and professional learning communities.

Hypothesis 2: Higher levels of implementation of PLC characteristics is a predictor of higher levels of teacher collective efficacy.

Methods

This article drew on data collected from a study which used a mixed-method research design to explore the relationship between teacher collective efficacy and implementation of professional learning communities in one mid-sized K–12 school district (Voelkel, 2011). The quantitative component provided an overall picture of the levels of implementation of the PLC characteristics and level of teacher collective efficacy in 16 of the district's 19 schools. The qualitatively component explored the differences of teacher perceptions of their work and school leadership between high- and low-functioning teams in three schools (Voelkel, 2011). The quantitative results showed that there were consistently high PLC mean scores (average mean score 4.45 on a 5-point scale) and teacher collective efficacy (TCE) (average mean score 4.37 on a 5-point scale) across all schools.

Context of the study

This study was conducted in a medium sized K–12 public school district in California. The district covers approximately 180 square miles and includes one main city, five

communities, and the suburban and rural areas of five additional cities. The district's eastern and southern areas are predominantly agricultural while the northern and western portions are largely suburban. The district serves approximately 10,200 students of diverse backgrounds: Hispanic or Latino (69%), White (18%), African American (2%), and Asian/Pacific Island (10%). Seventy percent receive free or reduced-price lunch, 29% are classified as Limited English Proficient, and 7% of students have been identified with disabilities. These students attend 19 schools with varying grade-level configurations (see Table 3). Although district enrollment has increased by about 500 students since the study was conducted, the demographic distribution has remained constant, and the number of students receiving free or reduced-price lunches has increased from 70% to 76%.

In 2003–2004, the school district was designated as a Program Improvement (PI) District, one of the first 98 districts in the state to be so designated, because the district failed to meet minimum proficiency levels for their English learner population. This prompted the district to extensively implement the professional learning community model developed by DuFour and Eaker (1998). Teacher team members and site principals from every school attended the 3-day PLC training conducted by DuFour and his team. This core team of teachers and administrators was tasked to train the rest of the staff. In subsequent years, principals and teachers who had not attended the initial DuFour training were given an opportunity to attend other DuFour sponsored training conferences. Other reforms were not undertaken in the first 4 years of PLC implementation (personal communication from the superintendent, 2010).

Since implementing this PLC model as its primary reform strategy in 2004–2005, the district's Academic Performance Index (API), California's measurement of student performance and progress, scores over the past 5 years increased from 599 to 766 points, a growth of 167 points. Additionally, the percent of students proficient in English Language Arts increased from 29% to 55.3% and math scores increased from 60% to 75% proficient. Within 2 years of implementing districtwide the PLC model, the district was removed from PI status.

Sample and data collection

Participants in this study include 310 teachers and principals from 16 schools (10 elementary, three K–8, two high schools, and one continuation school) in one district. All principals in the district were invited to participate. Out of 19 possible schools, only the district middle school declined to participate. Two other schools were removed from the study because teachers at these alternative schools go to students' homes and seldom meet as a team or staff. To increase survey response rate, the superintendent informed principals during a leadership retreat of the study and its importance to the district. They were encouraged to give teachers time during the work day (i.e., at a staff meeting) to complete the survey. All participants were informed that participation was completely voluntary and there were no job implications for completing it or not. Data for this study were collected in Fall 2009.

The overall return rate was high at 82%. Although several of the surveys contained missing data, especially within the demographic section of the survey, these were not eliminated because the demographic data were not used for this study.[1] For individual

surveys missing one or two values within the PLC and TCE sections, mean imputation was used to fill in the missing values (Fowler, 2009). There were no surveys returned missing more than two values; had there been, they would have been excluded from the study. Once surveys were returned and entered in the statistical package SPSS 17.0 for Windows, the data were examined for outliers and violations of assumptions of univariate outliers, univariate normality, as well as multivariate outliers and multivariate normality prior to conducting the statistical analysis. A total of 13 outliers (12 univariate and 1 multivariate) were identified but were not statistically significant so were not removed from the study. The response rate was 90.3% from the elementary (primary level), 80.3% from the K-8 level, and 81.5% from the high school teachers.

Survey instruments

The 34-question survey consisted of three parts: 9 demographic questions, 13 PLC questions, and 12 teacher collective efficacy questions.

Demographic component

The survey included nine demographic statements that sought information regarding age, gender, ethnicity, number of years of teaching, number of years of teaching at current site, highest educational level completed, school name, current professional learning community team, and grade levels currently teaching.

PLC component

The PLC component of the survey drew on a previously used survey developed by Grider (2008) that assessed PLC characteristics of 25 elementary, middle, and high schools within one school district. Grider's original survey consisted of 52 items. However, after having it reviewed to assess content validity by external PLC experts (as recommended by Groves et al., 2004), the survey was condensed to 12 items using a 5-point Likert scale ranging from *never* to *always*. Each survey item was constructed to represent a single idea allowing the researcher to assess each discrete aspect of PLCs. Grider's study results were based on 453 usable surveys, and the Cronbach's alpha test on the entire survey yielded a reliability coefficient of .89. A factor analysis was not conducted.

Before its use in our study, the experts who reviewed the survey originally, Richard and Rebecca DuFour, were asked to review the survey again. While they felt the survey still captured the essence of the PLC process, several revisions were suggested. They suggested breaking two statements into two because they addressed different ideas. The original Item 4 stated: *My team works collaboratively to clarify the criteria used to judge the quality of student work, and we practice applying those criteria until we can do so consistently*. We changed this statement into: A) *My team works collaboratively to clarify the criteria used to judge the quality of student work*. B) *We practice applying the above-mentioned criteria until we can do so consistently*. Item 8 was revised to read: A) *My team members use student achievement results from a variety of assessments to identify strengths and weaknesses in our individual and collective practice;* and B) *My team members use the above-mentioned student achievement results to improve our effectiveness in helping all students learn*. It was also suggested to drop the original Item 1: *I meet at least once every other week with my teacher team to work collaboratively on improving*

student learning. This decision was confirmed after conducting the exploratory factor analysis using the Varimax rotation method with Kaiser normalization.

Teacher collective efficacy component

The teacher collective efficacy section of the survey was adapted from the work of Goddard (2002). The original measure of Goddard et al. (2000) consisted of 21 items arrayed with a 6-point Likert scale (*strongly disagree* to *strongly agree*). Prior to field testing the instrument, it was reviewed by a panel of three experts at the University of Ohio. The panel's concerns were addressed by Goddard et al. (2000) prior to the study, which included 498 usable surveys. An analysis of the instrument's reliability revealed a Cronbach's alpha reliability coefficient of .96. A high correlation was found between the school efficacy score and school success on standardized achievement tests (Goddard et al., 2000).

Later, Goddard (2002) re-examined the 21-item measure Collective Efficacy Scale seeking to construct a more theoretically based version. A total of 452 usable surveys were collected from 47 schools located in one large urban Midwestern school district. The Cronbach's alpha reliability coefficient yielded scores with a high internal consistency of .94. The new study also revealed a single-factor solution explaining 64.10% of the variance. After conducting his 2002 study, Goddard reduced the original 21-item scale to 12 items. When comparing the short and long forms, the correlation between these scales ($r = .983$) suggests that the short scale is strongly related to the original longer scale. In the 12-item Collective Efficacy Scale, three of the statements reference Task Analysis (TA+) positively and three statements reference Task Analysis (TA-) negatively; three statements measure Group Competence (GC+) positively, and three statements reference Group Competence (GC-) negatively. For purposes of this study, we adapted this short version by keeping the meaning but changing some of the wording for a few questions. For example, instead of saying "difficult students" we used "challenging students". See Tables 1a and 1b for PLC and TCE survey questions.

Pilot study

Once the survey instrument was developed and the PLC section reviewed by experts in the field as previously mentioned, a pilot study of the 34 items was administered to a sample of 45 participants to add further validity. The surveys were administered through Survey Monkey, an online survey instrument, in two elementary schools located in two different districts in southern California. There was also an opportunity for participants to provide feedback on each of the three sections to increase clarity, reliability, and validity. Analysis and factor analysis of survey responses were completed to determine if any questions needed to be eliminated to increase instrument stability. Based on the data, no further adjustments were made.

Data analysis

The data analysis included four types of statistical tests. First, exploratory factor analyses were conducted (using the Varimax rotation method with Kaiser normalization) to provide evidence of validity for the PLC and TCE measures. Second, descriptive statistics were used to illustrate the mean and standard deviation for the overall PLC and TCE measures by school. Third, Pearson's *r* correlation was used to assess the association between the three PLC and two TCE constructs as well as the total PLC and total TCE measures. Finally, SEM was

Table 1. a. Professional learning community survey questions and factor loadings based on exploratory factor analysis. b. Teacher collective efficacy survey questions and factor loadings based on exploratory factor analysis.

Table 1a

PLC Factor	PLC Survey Questions	Factor Loadings
Collective Goals	3. My team works collaboratively to clarify the criteria used to judge the quality of student work.	.574
	5. My team monitors the learning of each student at least four times each year on essential outcomes through a series of team-developed (common) formative assessments that are aligned with district and state standards.	.880
	11. My team works interdependently to establish and achieve SMART goals (SMART goals are Strategic, Measurable, Attainable, Results-Oriented, and Time-Bound).	.834
	12. Improved results, achievement of goals, and the work of teams are the basis for a culture of celebration within classrooms and the school.	.562
	13. The shared vision and values among my school's staff influence policies, procedures, daily practices, and day-to-day decisions of all staff members.	.722
Collective Actions	2. My team works together to establish common pacing for each unit of instruction.	.784
	4. We practice applying criteria to judge student work until we can do so consistently.	.613
	9. My team members use student data to improve teacher effectiveness to improve our effectiveness in helping all students learn.	.651
	10. My team has adopted specific and explicit norms and protocols that guide us in working together.	.716
Focus on Results/ Data Use	1. My team works together to clarify the essential outcomes for each unit of instruction using state and local standards and resources as well as student achievement data.	.642
	6. Students who experience academic difficulty are guaranteed access to a system of interventions that provide more time and support for learning.	.866
	7. Students are required rather than invited to devote extra time and receive additional support until they are successful.	.792
	8. My team members use student achievement results from a variety of assessments to identify strengths and weaknesses in our individual and collective practice.	.531

Table 1b

Teacher Collective Efficacy Factor	Teacher Collective Efficacy Questions	Factor Loadings
Group Competency	14. Teachers in this school work together to meet the needs of challenging students.	.743
	15. Teachers here are confident they will be able to motivate their students.	.781
	16. Teachers in this school believe it is their responsibility to help every child master the grade-level curriculum.	.721
	17. If a child doesn't want to learn, teachers here give up.	.579
	18. Some teachers at my site lack the skills needed to ensure every child can master the grade-level curriculum.	.569
	19. If these students come to school unprepared to learn, teachers have the skills to close the learning gap.	.721
Task Analysis	20. Teachers provide so many engaging lessons that the students here are bound to learn.	.767
	21. Students here just aren't motivated to learn.	.405
	22. The structures, practices, and procedures of this school are designed to help ensure all students learn.	.671
	23. Learning is more difficult at this school because students are worried about their safety.	.450
	24. Teachers at this school have strategies for supporting students who face home life difficulties.	.578
	25. Teachers in this school help each other incorporate critical thinking opportunities for their students when planning lessons.	.736

conducted to explore the conceptual path model between the PLC and TCE constructs. All statistical procedures were conducted using the statistical package SPSS 17.0 for Windows except for the structural equation models, which were tested using EQS 6.1 (Byrne, 2006).

Exploratory factor analysis (PLC & TCE)

As a means of identifying the PLC and TCE constructs for this sample of respondents, we performed an exploratory factor analysis (see Tables 1a and 1b). The findings indicated many coefficients of .3 or higher. The Kaiser-Meyer-Olkin value was .90, which exceeded the recommended value of .6 or higher. Additionally, the Bartlett's Test of Sphericity was statistically significant at $p < .001$. Principal component analysis showed five factors with eigenvalues greater than 1, explaining 56.73% of the variance. Examination of the screeplot showed a clear break after the fifth factor.

Based on the data, groups of items were combined to create five composite variables. The PLC variables fell into one of three groups: Collective Goals (Item numbers 3, 5, 11, 12, 13), Collective Actions (2, 4, 9, 10), and Focus on Results (1, 6, 7, 8). The teacher collective efficacy variables fell into one of two groups: Group Competency (14, 15, 16, 17, 18, 19) and Task Analysis (20, 21, 22, 23, 24, 25). All coefficients were .3 or higher. Per Pallant (2007), many coefficients should be above .3. The Kaiser-Meyer-Olkin value was .78, exceeding the recommended value of above .6 (Pallant, 2007). The Bartlett's Test of Sphericity revealed statistical significance at $p < .001$. A review of the total variance explained showed one component with an eigenvalue greater than 1, explaining 62.40% of the variance. An analysis of the screeplot revealed a clear break after the first component. The items loaded as expected.

Results

The district mean scores for each of the PLC survey questions were used to examine the overall levels of professional learning community characteristics employed within teacher PLC teams. The Cronbach's alpha reliability of .89 for PLC items showed strong internal consistency. Based on the 5-point Likert scale, the district's overall PLC mean score was 4.45. This is evidence of a high level of PLC characteristics implemented within this district. Over 75% of the participants responded with a 4 or 5 for each of the PLC questions suggesting that the majority of respondents perceive that most activities associated with their PLC teams are happening in their schools. It is notable that fewer than 6% of the participants reported a score of 1 or 2 for any of the question items. The district's sustained implementation and support for PLCs for over a 5-year period may be one possible explanation for the high mean scores. Table 2 provides each school's overall PLC and TCE mean scores as well as standard deviation, the 2004 Academic Performance Index (API), and API change over a 5-year period since implementing the PLC model.

What is the relationship between variables measuring teacher collective efficacy and variables measuring PLC characteristics?

Several analyses were conducted for the PLC and TCE survey factors. The first set of data collected was from the Pearson Product Moment Correlation Coefficient Test represented in Table 3. All items of the PLC and TCE survey sections were combined to represent a PLC total score and total TCE. Additionally, the PLC and TCE surveys

Table 2. Overall site descriptive professional learning community (PLC) and teacher collective efficacy (TCE) statistics.

School	Overall PLC Mean	Overall TCE Mean	PLC *SD*	TCE *SD*	API 2004 Chang	5 Year API
Elementary Schools (E.S.)						
E.S. 1	4.72	4.67	.42	.21	577	+171
E.S. 2	4.82	4.74	.23	.28	N/A	+32*
E.S. 3	4.29	4.25	.63	.44	702	+45
E.S. 4	4.58	4.30	.39	.48	640	+132
E.S. 5	4.44	4.33	.48	.55	673	+77
E.S. 6	4.79	4.64	.30	.23	697	+89
E.S. 7	4.10	4.63	.37	.24	676	+116
E.S. 8	4.91	4.80	.15	.30	786	+40
E.S. 9	4.11	3.72	.49	.47	613	+93
E.S. 10	4.44	4.10	.41	.45	601	+171
K–8 Schools (K–8)						
K–8 1	4.34	4.54	.46	.29	778	+78
K–8 2	4.37	4.28	.48	.40	829	+76**
K–8 3	4.36	4.31	.52	.42	721	+100
Day School (D.S.)						
D.S. 1	4.38	4.20	.34	.17	N/A	+124
High Schools (H.S.)						
H.S. 1	4.28	4.18	.57	.42	359	+193
H.S. 2	4.33	4.25	.47	.41	680	±28

Mean scores based on a 5-point Likert Scale. *SD* = standard deviation. Although there was variation in API results, all gains were considered significant because they were sustained over time.
*School opened in 2008–2009 school year. Data indicate 2 years' growth. School's API was above 800 the first year the scores were reported. The API is the Academic Performance Index used by the state of California to assess student growth in achievement.
**School's API was above 800 five years ago.

Table 3. Correlations among professional learning community subscales and teacher collective efficacy subscales (N = 310).

	1	2	3	4	5	6	7
PLC Total	–						
TCE Total	*.518***	–					
Collective Goals	.915**	*.533***	–				
Collective Actions	.915**	*.432***	.788**	–			
Collective Results	.858**	*.433***	.676**	.650**	–		
Focus							
Group Competence	*.409***	.924**	*.439***	*.331***	*.334***	–	
Task Analysis	*.547***	.912**	*.542***	*.466***	*.465***	.687**	–

**Correlation is significant at the 0.01 level (2-tailed) $p < .01$.
Italics: Correlation between PLC & TCE total or subscales.

subscales were analyzed. In analyzing the PLC total with the TCE total, a significant correlation was discovered ($r = .518$; $p < .01$) suggesting a positive relationship between teachers' perceived degree that their team functions as a professional learning community and their level of perceived collective efficacy.

Total PLC was also found to be significantly correlated to Group Competence ($r = .409$; $p < .01$), and Task Analysis ($r = .547$; $p < .01$) demonstrating further evidence that PLC team work as perceived by teachers is related to their level of collective efficacy. The findings indicate that when teachers view themselves as a well-functioning PLC team, their level of perceived collective efficacy may be increased. Overall, the findings show a strong, positive correlation between the following variables as demonstrated in Table 3.

Next, SEM model testing was conducted using the same five grouped variables explained previously. SEM is a series of statistical methods testing the goodness of fit of data to a proposed model. Certain criteria must be met to ensure mediation in the model. The independent and dependent variables must all be correlated (Baron & Kenny, 1986). Further, SEM is extremely sensitive to sample size. We used SEM with EQS 6.1 for Windows to test the fit of the hypothesized path model.

Figure 2 displays the goodness-of-fit indices for the relationship between the independent variables, Collective Goals/Collective Actions/Focus on Results, and the dependent variables, Group Competency and Task Analysis. Model fit decisions were based on four indices: comparative fit index (CFI), normed fit index (NFI), goodness-of-fit index (GFI), and root mean square error of approximation (RMSEA). SEM literature suggests that model fit is excellent when the coefficient for CFI, NFI, and GFI is greater than 0.95; and model fit for the three is considered adequate if the coefficient is greater than 0.90 (Byrne, 2006; Hu & Bentler, 1999), with a perfect fit indicated with a score of 1.00. A coefficient less than 0.05 demonstrates an excellent fit, and a coefficient under 0.08 indicates an acceptable fit for the RMSEA (Kline, 1998) and should fall between the range indicated by the 90% confidence interval of RMSEA. Cronbach's alpha should be at least .70. For the proposed model, all model fit indices demonstrate an adequate fit of the data to the model, with the CFI = .902, the NFI = .903, and the GFI = .911. The data revealed the RMSEA of .515 to be greater than the recommended .08 but within the 90% confidence interval of RMSEA. Cronbach's alpha of .834 indicates strong reliability of the model.

Figure 2 also shows the path analysis results for both standardized and unstandardized coefficients. The unstandardized coefficients are in parentheses. Tabachnick and Fidell (2007) state that it is sometimes difficult to interpret unstandardized regression coefficients because of differences in scales; therefore, we examined the standardized

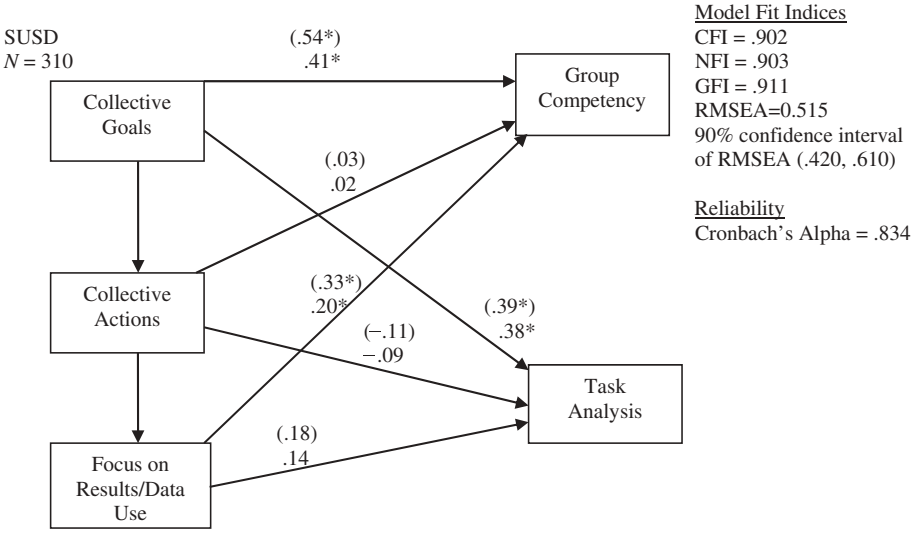

Figure 2. Path Analysis of Collective Goals/Collective Actions/Focus on Results and Group Competency and Task Analysis with standardized (and unstandardized) coefficients.
*indicates statistically significant at 0.05 level.

coefficients for this study. The paths from each of the PLC variables to the TCE variables are standardized factor loadings. The results demonstrate that the presence of PLC characteristics is a predictor of higher levels of perceived teacher collective efficacy as noted by a positive relationship between two of the PLC variables. In other words, increased agreement among Collective Goals is a significant indicator of increased levels of Group Competency and Task Analysis; the more the PLC team agrees to Collective Goals, the greater the level of Group Competency and Task Analysis, indicating increased levels of teacher collective efficacy. Similarly, Focus on Results, which included analysis and use of student data, is also a positive predictor of increased Group Competence and Task Analysis.

Discussion and conclusions

The purpose of this study was to explore the predictive relationship between two key school improvement constructs: professional learning communities and teacher collective efficacy. Previous studies had presented contrasting findings, with some concluding PLCs predicted higher levels of efficacy and others the reverse.

Our findings show (a) there is a positive and high correlation between PLC implementation and teacher collective efficacy; and (b) higher levels of perceived implementation of PLC variables are predictive of high levels of teacher collective efficacy. Thus, this study confirms J.C. Lee et al.'s (2011), Moolenaar et al.'s (2012), and other scholars' work that PLCs predict teacher collective efficacy, not the reverse. The data indicate that two key PLC practices (setting collective goals and focusing on results – analyzing data and using it to see strengths and weaknesses in practices and develop interventions) proved significant in predicting higher group competency. Collective goal setting also had a significant effect on teachers' perception that they will be able to meet the needs of all students through helping each other develop engaging lessons and fostering students' critical thinking (Task Analysis). These findings about key aspects of PLC work that make a difference confirm findings of Visscher and Witziers (2004), who concluded that to have an impact on student learning teachers needed to do more than share goals and lessons. Teachers had to actively engage in data analysis and use the information to improve teaching and student learning. In our study, teacher efficacy was fostered from doing the PLC work of analyzing student data and work and deciding what interventions or changes in instruction were needed to ensure students' mastered learning goals.

Our study suggests engaging in a practice influences teachers' beliefs in their ability (efficacy) to accomplish goals. These findings are similar to those of a number of other scholars who have worked to understand the interaction between teacher beliefs and changes in practice (Crandall, 1983; Fullan, 1985; Guskey, 2002; Huberman, 1981; Timperley & Phillips, 2003). Guskey (1997) found that teachers who implemented a mastery learning program and saw student gains believed (on an affective measure) that they had a powerful influence on student learning; whereas teachers who did not see improvements or who did not implement the practices did not perceive increased influence. His findings showed that although professional development and implementation were important for changing beliefs, equally significant was teachers seeing results. Timperley and Phillips (2003) also found that opportunities for teachers to

participate in a literacy professional development program, which developed both pedagogical skills and content knowledge, changed their beliefs about "what children from low-income communities are able to learn" (p. 639). As they saw these children achieving in ways they had not experienced before, the teachers' sense of self-efficacy was also enhanced. These studies as well as ours confirm an important relationship between professional development, implementation of new practices, and seeing results (which the case study teachers experienced over the 5 years of PLC implementation) in enhancing teacher self- and, in the case of this study, collective efficacy.

The significance between PLCs and TCE (and our own practical experience) suggests that there is most likely a reciprocal relationship between these two constructs. This close relationship may help to explain why some studies have shown TCE as predictive of fuller implementation of PLCs. In this case, the district had been implementing PLCs in all its schools for over five years when the study was conducted. The high PLC mean scores across all schools may indicate that many of the challenges of implementing a new improvement program have been overcome. In contrast, other studies may have been conducted when PLCs were relatively new. In these cases, it could be that teams with higher TCE were early adopters and able to move more quickly in implanting PLCs than their compatriots.

Implications for practice

Several practical implications can be drawn from this and other studies. In schools initiating a PLC process, leaders and team members may want to begin by assessing current strengths in assessing student work and teacher skills in drawing inferences about their instructional practices based on that work. Such an analysis draws teachers immediately into the heart of PLC work and at the same time helps team members see they have some strengths they can draw on to engage in PLC work. This study also highlights the importance of collectively developing clear goals to guide the team's work. Another implication is that teachers need regular and dedicated time to engage in PLC work, as all the teachers experienced in this study. Although not all teachers received the same level of professional development in the adopted PLC process, every team had a member or two who did. Given the district's sustained focus on PLCs as its primary reform, this seemed sufficient to yield substantial learning gains in every school, but probably not the same level of team effectiveness in every school (Voelkel, 2011). Finally, since higher levels of PLC implementation, in this and other studies, are predictive of higher levels of collective efficacy, school leaders may be best able to help struggling PLC teams by assisting them in setting clear achievable goals, in analyzing student work, in understanding how instruction shapes the student outcomes, and in using protocols to identify next instructional steps – all key PLC implementation variables.

Areas for future research

This study lays the groundwork for future and broader studies involving more districts and schools to continue to tease out the relationship between specific PLC practices (as Goddard et al., 2015, suggest), TCE, and student achievement. Using HLM as the

analytical tool, as J.C. Lee et al.'s (2011) and Moolenaar et al.'s (2012) did in their studies, would allow the PLC and TCE variables to be analyzed with student achievement as the outcome. Future studies that explore the relationship of these variables among PLCs at different stages of development would be valuable and may provide insights into the reciprocal nature of these two constructs. Equally desirable would be studies that investigate the nature and extent of professional development needed to effectively foster both pedagogical and content knowledge needed by teams to significantly raise student achievement in substantive ways.

Note

1. Several one-way and two-way analysis of variance tests were conducted to see what, if any, statistically significant differences the demographic data revealed in relation to PLC and TCE. No statistically significant difference was found in analysis of the data.

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Disclosure statement

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