



Toward Conceptual Clarity: A Multidimensional, Multilevel Model of Professional Learning Communities in Dutch Elementary Schools

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TOWARD CONCEPTUAL CLARITY

A Multidimensional, Multilevel Model of Professional Learning Communities in Dutch Elementary Schools

ABSTRACT

Despite the popularity of professional learning communities (PLCs) among researchers, practitioners, and educational policy makers, studies on PLCs differ significantly on the dimensions and capacities used to conceptualize them. Further, the interrelatedness of different dimensions and capacities within PLCs is not often well conceived nor examined in terms of learning at multiple (individual, team, school) levels. In an effort to address this gap, this study assesses the multidimensional, multilevel nature of PLCs using data from 992 teachers from 76 Dutch elementary schools. Findings indicate that professional learning communities within elementary schools can be conceptualized and assessed by 3 strongly interconnected capacities that are represented by 8 underlying dimensions. This conceptual structure empirically emerged as equivalent at both the teacher and school levels. By providing increased insight into the multidimensional, multilevel nature of the concept of PLCs, this article aims to add conceptual clarity to the study of PLCs in elementary education.

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DURING the past decade, there has been a global trend in education involving pressure for higher student performance, often driven by rigid policies (Daly, 2009, 2012). Schools in general, but elementary schools in particular, have had to be responsive to these high-stakes accountability policies that enforce tightened “output” controls as a means to raise student perfor-

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mance. In response to this external pressure from national and local educational policies, many schools are increasingly involved in large-scale educational reforms directed at strengthening elementary teachers' professional expertise and practice, with the ultimate goal of increasing student achievement. In the Netherlands, where this study takes place, these reforms are often aimed at the development of professional learning environments designed to stimulate self-regulated, authentic, and social-interactive learning (De Kock, Slegers, & Voeten, 2004).

Reforms implemented at the elementary level typically aim to build school- and teacher-level capacity through professional development initiatives (Coburn, Russell, Kaufman, & Stein, 2012; Leithwood & Louis, 1998; Smylie & Hart, 1999). Building capacity by promoting teachers' individual and collective learning is considered an important prerequisite for a school's ability to change and sustain improvement (Atteberry & Bryk, 2011; Hopkins, 2001; Parise & Spillane, 2010; Slegers, Bolhuis, & Geijssel, 2005). Coupled with this emphasis on capacity, there has also been increased practical and scholarly attention to teacher professional learning (Doppenberg, den Brok, & Bakx, 2012; Hord, 1997; Mitchell & Sackney, 2000; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Toole & Louis, 2002). One of the most prominent and promising concepts in this literature is the idea of the professional learning community (PLC).

Despite the rising popularity of professional learning communities among researchers, practitioners, and educational policy makers, research on PLCs is still in a developmental stage of theory building (Lomos, 2012; Stoll et al., 2006; Toole & Louis, 2002; Vescio, Ross, & Adams, 2008). Researchers employ a variety of terms to describe how teachers' individual and collective learning is embedded in schools and linked with school-wide capacity for improvement, such as community of practice, organizational (shared, collaborative, collective) learning, professional community, (school) learning community, and school-based teacher learning community (Lee & Smith, 1996; Louis & Marks, 1998; Louis, Marks, & Kruse, 1996; McLaughlin & Talbert, 2001; Mitchell & Sackney, 2000; Newmann, King, & Youngs, 2000). Many studies on PLCs differ significantly on the dimensions and capacities used to conceptualize them. In addition, the interrelatedness of different dimensions and capacities is not often well conceived, nor are these concepts well examined in terms of learning at multiple (individual, team, school) levels. As a consequence of this variation, there is limited conceptual clarity and focus. Furthermore, scholars tend to foreground the normative nature of PLCs with limited attention to the validation of this multidimensional, multilevel concept. In response to the gaps in the literature, our study puts forth and tests a conceptual model of PLCs using data from 992 teachers in 76 Dutch elementary schools.

Theoretical Framework

Professional Learning Community: Capacities and Dimensions

Although there is no universal definition of a professional learning community, there appears to be broad international consensus about the tenor of the concept (Bolam et al., 2005). The notion of PLCs is grounded in the assumption that what teachers do together outside their classrooms can be as important as what they do inside for school improvement, teachers' professional development, and student

learning. A professional learning community is a group of educators who are sharing and critically reflecting on their practice in order to enhance the learning of students and teachers, thereby supporting school development (Bolam et al., 2005; Hord, 1997; Mitchell & Sackney, 2000; Verbiest & Vandenberghe, 2002).

The development and use of the concept of PLCs in theory and practice is constrained by several conceptual and empirical challenges (Stoll et al., 2006; Toole & Louis, 2002; Vescio et al., 2008). One of the main conceptual challenges facing the concept of PLCs is their multidimensional, multilevel nature. In order to conceptualize PLCs, researchers have used different dimensions that are thought to be inter-related. For instance, while some scholars consider individual learning to be one of the key dimensions of a PLC (Mitchell & Sackney, 2000), other researchers do not mention this dimension at all (Hord, 1997, 2004). Studies on PLCs also place a differential emphasis on the importance of the dimensions that constitute PLCs. For example, the same dimension (e.g., leadership, time to meet and talk) can be treated as one of the key dimensions of PLCs (Hord, 2004), but in other studies is referred to as a supportive condition (Louis et al., 1996).

While many studies assume that the dimensions that underlie PLCs are interrelated (Hipp & Huffman, 2003; Hord, 1997, 2004; Huffman & Hipp, 2003; Mitchell & Sackney, 2000; Sackney et al., 2005), this assumption is, from our perspective, neither theoretically grounded nor systematically validated. In most studies, researchers used factor analyses to demonstrate that the different PLC dimensions could be distinguished as separate factors (e.g., Bryk, Camburn, & Louis, 1999; Hipp, 2005; Huffman & Hipp, 2003; Visscher & Witziers, 2004; Wahlstrom & Louis, 2008), while in other studies, researchers used a standardized index that represented the sum of separate factors to operationalize professional community (e.g., Louis et al., 1996; Louis & Marks, 1998; Marks & Louis, 1999). In only one study did researchers use second-order factor analyses to determine whether the separate dimensions measured a single underlying organizational construct, professional community (Bryk et al., 1999).

Although scholars use different dimensions, they generally conceptualize professional community as including elements such as shared values and vision, teacher collaboration, reflective professional inquiry, and collective and individual learning (Louis & Marks, 1998; Mitchell & Sackney, 2000; Stoll et al., 2006; Toole & Louis, 2002). However, the assumption that separate dimensions refer to underlying latent constructs such as professionalism, learning, community, or different sets of capacity has had limited rigorous testing (Lomos, 2012). As a consequence, some researchers complain that the concept of professional community is “fuzzy” (Westheimer, 1999).

In addition, while research into PLCs is typically conducted in school settings that are hierarchically nested by nature, only a few studies examine the multidimensional nature of the concept of PLCs at multiple levels of analysis. It is often assumed that effective PLCs develop school-wide capacity for professional learning on both the individual (teacher) and collective (school) levels. To address this assumption, scholars often use a system theory that links the structural and cultural dimensions of school workplace environments to professional learning in order to conceptualize PLCs. However, most studies only perform single-level factor analyses at the teacher level to test the validity of the construct. The few studies that used multilevel analyses (HLM) focused on antecedents of PLCs, such as contextual and school factors that promote PLCs, or the effect of PLCs on organizational learning, rather than focusing

on the multidimensional, multilevel nature of the concept of the PLC itself (Bryk et al., 1999; Marks & Louis, 1999).

In their conceptualization of PLCs, Mitchell and Sackney have provided more attention to the multidimensional, multilevel nature of PLCs through focusing on three sets (personal, interpersonal, and organizational) of mutually related capacities (Mitchell & Sackney, 2000; Sackney, Walker, Mitchell, & Duncan, 2005). Personal capacity relates to the active and reflective construction of knowledge. Interpersonal capacity relates to the ability of people to work together on shared purposes. Organizational capacity relates to organizational structures that create and maintain sustainable organizational processes for individual and collective learning and improvement. Using factor analyses, Sackney et al. (2005) found five scales (alphas ranging from .56 to .83) describing the underlying dimensions of a PLC, namely, reflective practice and currency (personal capacity), shared understanding (interpersonal capacity), and organizational resources and learning opportunities (organizational capacity). Furthermore, they found a sixth environmental factor: quality of work life as experienced by the staff (i.e., enjoying their work environment, feeling appreciated for their efforts and low-conflict relationships). Mitchell and Sackney (2000) also emphasized the importance of the interdependency of the three different capacities for the development of a PLC. Although they assume that interdependency is important for the quality and effectiveness of PLCs, this assumption has not yet been tested.

In this article, we propose a model of PLCs grounded in mainstream PLC literature from the past 2 decades. Using this model, we aim empirically to validate the concept of the professional learning community and provide increased nuanced understanding of the interplay between different levels of capacity and related dimensions that are proposed in the literature.

Modeling the PLC as a Multidimensional, Multilevel Concept

Drawing on Mitchell and Sackney's work on professional learning communities, we identify three levels of capacity building within PLCs, namely, capacity at the personal, interpersonal, and organizational levels (Mitchell & Sackney, 2000; Sackney et al., 2005). Effective PLCs develop capacity for professional learning on the individual, interpersonal, and school levels in order to improve student learning (Mitchell & Sackney, 2000; Stoll & Louis, 2007). Building on the literature, we propose a conceptual model in which we describe these three capacities and their proposed underlying dimensions (see Fig. 1).

Personal capacity refers to individuals' ability to actively and reflectively construct knowledge about teaching and student learning. In a PLC, educators constantly reflect on, assess, critique, and reconstruct their personal knowledge by using available sources of information and knowledge that reside in their environment. *Interpersonal capacity* indicates the ability of people to work together on shared purposes. In a PLC, educators attend to the affective and cognitive climate in their school, take individual and collective responsibility for the well-being and learning of others, and operate in a spirit of mutual respect and psychological safety. *Organizational capacity* refers to organizational structures that create and maintain sustainable organizational processes for individual and collective learning and improvement.

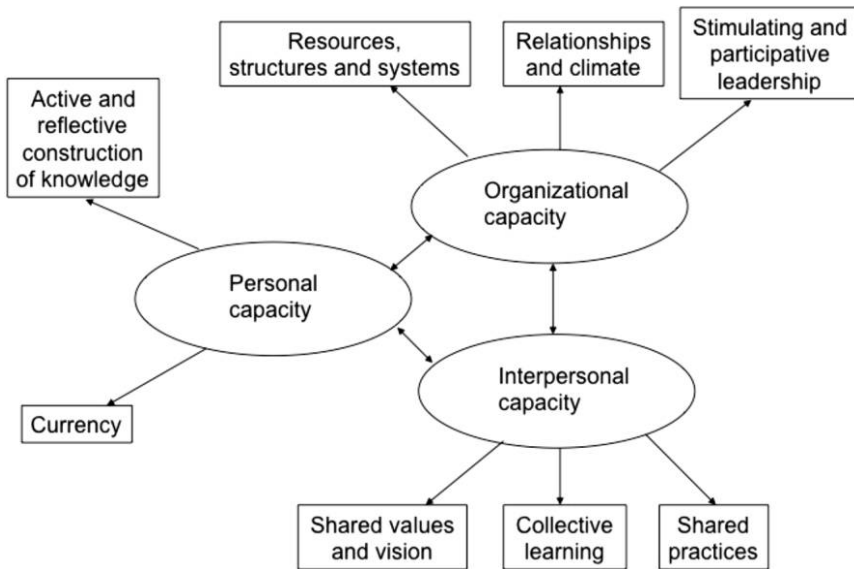


Figure 1. Conceptual model.

In this article we distinguish eight dimensions from the literature around PLCs that may underlie each of the three capacities mentioned above (personal capacity, interpersonal capacity, and organizational capacity). The level of personal capacity within PLCs may be described by two dimensions, namely, active and reflective construction of knowledge and currency. The first dimension, *active and reflective construction of knowledge*, reflects teachers' personal capacity that contributes to the development of PLCs. This dimension is sometimes referred to as reflective professional inquiry, an internal enquiry orientation, or individual learning (Stoll et al., 2006) and encompasses the clarification, examination, and adaption of teachers' cognitive structures and theories (McLaughlin & Talbert, 2001; Mitchell & Sackney, 2000). In addition, the second dimension, *currency*, constitutes teachers' personal capacity within PLCs in the form of applying recent scientific knowledge and best practices (Mitchell & Sackney, 2000).

While only a few studies define PLCs partly in terms of educators' personal capacity, much more attention has been paid to dimensions of PLCs that underlie the interpersonal capacity of educators. A first common dimension of interpersonal capacity can be described as *shared values and vision*. The presence of shared beliefs about learning and instruction and a common focus on the improvement of students' learning is often identified as a key dimension of strong teacher professional communities (Bryk et al., 1999; Louis & Marks, 1998). Others refer to a similar dimension using terms such as shared understanding (Sackney et al., 2005), shared values and vision (Hord, 1997, 2004; Huffman & Hipp, 2003; Stoll et al., 2006), professional and pupil learning ethos (Bolam et al., 2005; Stoll et al., 2006), and consensus (Visscher & Witziers, 2004). A second often-cited dimension of interpersonal capacity may be described as *collective learning* (Hipp, 2005; Hipp & Huffman, 2003; Hord, 1997, 2004; Huffman & Hipp, 2003). This dimension comprises several elements related to collective learning and applications of collective learning, such as group learning and external enquiry orientation (Bolam et al., 2005), reflective dialogue (Bryk et al., 1999; Louis & Marks, 1998; Louis et al., 1996), and consultation and

cooperation (Visscher & Witziers, 2004). A third commonly cited dimension of interpersonal capacity in support of PLCs is *shared practices* (Hipp & Huffman, 2003; Hord, 1997, 2004; Huffman & Hipp, 2003; Mitchell & Sackney, 2000). This dimension involves the sharing of practices between teachers in order to improve student learning, which is also referred to as teachers' deprivatized practice (Bryk et al., 1999; Louis & Marks, 1998; Louis et al., 1996) and encompasses elements of teacher collaboration (Bolam et al., 2005; Bryk et al., 1999; Louis & Marks, 1998; Louis et al., 1996).

Finally, at the level of organizational capacity we identify three dimensions that refer to the organizational conditions facilitating the development of PLCs. First, a recurring theme in PLC literature is the need for organizational conditions in the form of supportive *resources, structures, and systems* that shape organizational capacity. Among these are the amount of time, information, materials, and other resources available in the school (Atteberry & Bryk, 2011; Mitchell & Sackney, 2000; Mulford, Silins, & Leithwood, 2004); supportive and shared decision making (Louis et al., 1996; Visscher & Witziers, 2004); and organizational resources and learning opportunities (Sackney et al., 2005). Second, the dimension of educators' *relationships and climate* of the school also reflects the organization's capacity and is suggested to play an important role in PLCs (Finnigan & Daly, 2012; Moolenaar & Daly, 2012). Elements that are associated with this dimension are mutual trust, respect, and support among staff members, inclusive membership and openness, and partnerships (Atteberry & Bryk, 2011; Bryk & Schneider, 2002; Hipp, 2005; Hord, 1997, 2004; Huffman & Hipp, 2003; Louis et al., 1996; McLaughlin & Talbert, 2001; Moolenaar, 2012; Stoll et al., 2006); (social) networks (Moolenaar & Daly, 2012; Moolenaar, Slegers, & Daly, 2011; Penuel, Sun, Frank, & Galligher, 2012; Spillane & Kim, 2012); teacher socialization and organizational social conditions (Baker-Doyle, 2011; Leithwood & Louis, 1998; Marks & Louis, 1999); and quality of work life (Sackney et al., 2005). Third, most studies of PLCs acknowledge the importance of *stimulating and participative leadership* as a key dimension that is part of the organizational capacity that fosters PLCs. This dimension refers to the degree to which school and departmental leaders support and stimulate teacher learning, delegate responsibilities, and share leadership functions (Geijssels, Slegers, Stoel, & Krüger, 2009; Geijssels, Slegers, Van den Berg, & Kelchtermans, 2001; Mitchell & Sackney, 2000; Moolenaar, Daly, & Slegers, 2010; Mulford et al., 2004; Spillane, 2006; Spillane & Kim, 2012; Visscher & Witziers, 2004). Together, the three capacities (personal, interpersonal, and organizational) and their eight underlying dimensions form a conceptual model of PLCs that we will use to test the multidimensional, multilevel nature of PLCs within Dutch elementary schools.

Method

Sample

The data we used to test our conceptualization of the school-based PLC came from the Dutch Capacity Building in Professional Learning Communities Questionnaire (CBPLC; Verbiest, 2008), which was administered to teachers in 76 elementary schools in the south of the Netherlands. Dutch schools comprise grades ranging from kindergarten (age 4) through grade 6 (age 12). The majority of the schools (44 of the 76) participated because their principals attended an in-service training at the Fontys

University of Applied Sciences that was aimed at the development of schools as PLCs, and involved elements such as seminars, school support, and data-based feedback. Another 16 schools participated because they were involved in a school improvement project aimed at developing their capacity to become a PLC. In addition, we asked another 16 so-called partner schools to administer the CBPLC Questionnaire. These partner schools were teacher training schools of the Department of Teacher Training at the Fontys University. After returning the questionnaires, the schools received a report with the results for their school.

In total, 992 teachers from 76 schools completed the questionnaire, resulting in an overall teacher response rate of 72%. The number of participating teachers varied per school and ranged between 7 and 55. Of the sample, 82% were female. The majority of the teachers were over 40 years of age, with 25% being younger than 30, 48% between 30 and 50, and 27% older than 50. Almost half of the sample (44%) worked full time at the school (40 hours per week), 40% of the sample worked between 20 and 40 hours per week, and 16% worked part time (less than 20 hours per week). In general, most of the teachers were very experienced, with 40% having more than 20 years of experience as a teacher, 40% between 5 and 20 years of experience, and 20% less than 5 years of experience.

Instruments

As mentioned above, we drew on Mitchell and Sackney's work in conceptualizing the concept of PLCs, given their attention to the multidimensional, multilevel nature of the concept (Mitchell & Sackney, 2000). In this study we developed a composite instrument designed to assess PLCs by the three capacities and eight underlying dimensions. First, we included items and subscales from the Building Capacity for a Learning Community Questionnaire as developed by Sackney and colleagues (Sackney et al., 2005). In addition, we used items from the Professional Learning Community Assessment Questionnaire as developed by Huffman and Hipp (2003), as well as items from other existing instruments focused on leadership practices (Geijsel et al., 2009; Mulford et al., 2004). By combining these three questionnaires with a few newly designed items into one composite instrument, we covered the three capacities and eight underlying dimensions of the concept of PLCs suggested in our review of the literature (see Fig. 1). In specific, the instrument was composed as follows:

- Active and reflective construction of knowledge (personal capacity) was measured using the subscale Reflective Practice from the Building Capacity for a Learning Community Questionnaire (Sackney et al., 2005).
- Currency (personal capacity) was assessed using a subscale of the Building Capacity for a Learning Community Questionnaire as developed by Sackney and his colleagues (Sackney et al., 2005).
- Shared values and shared vision (interpersonal capacity) was measured using a composite scale from several existing instruments. We included two items from the subscale Shared Values and Vision from the Professional Learning Community Assessment Questionnaire (Huffman & Hipp, 2003), one item from the subscale Shared Understanding of the Building Capacity for a Learning Community Questionnaire (Sackney et al., 2005), and one newly formulated item.

- Collective learning (interpersonal capacity) was measured using four items of the subscale Collective Learning and Application included in the Professional Learning Community Assessment Questionnaire (Huffman & Hipp, 2003).
- Shared practices (interpersonal capacity) was measured using two items of the subscale Shared Personal Practice from the Professional Learning Community Assessment Questionnaire (Huffman & Hipp, 2003) and two newly formulated items.
- Resources, structures, and systems (organizational capacity) was measured using four items from the subscale Supportive Conditions: Structures from the Professional Learning Community Assessment Questionnaire (Huffman & Hipp, 2003) and one item from the subscale Organizational Resources from the Building Capacity for a Learning Community Questionnaire (Sackney et al., 2005).
- Relationships and climate (organizational capacity) was measured using four items from the subscale Supportive Conditions: Relationships included in the Professional Learning Community Assessment Questionnaire (Huffman & Hipp, 2003).
- Stimulating and participative leadership (organizational capacity) was measured using items from three subscales—Intellectual Stimulation, Individual Support, and Structure—from the Leadership for Organizational Learning and Improved Student Outcomes Questionnaire (Mulford et al., 2004) and one item from the subscale Intellectual Stimulation from the Dutch School Improvement Questionnaire (Geijsel et al., 2001; see also Geijsel et al., 2009).

We carefully translated and adapted English items for their appropriateness in the Dutch elementary educational context using language experts and back-translation, and through member-checking procedures with our Dutch and U.S. team. To verify the face validity of the items, experts and school leaders from schools that were not involved in the study reviewed item formulations. All items were included in the CBPLC Questionnaire for teachers (Verbiest, 2008) (see Table 1). Teachers could indicate the extent to which the items applied to them on four-point scales, ranging from 1 = strongly disagree to 4 = strongly agree.

Analytic Strategy

We used Mplus3 (Muthén & Muthén, 2004) to analyze the measurement and structural models. First, we constructed measurement models for the items that were used to assess the eight dimensions (i.e., active and reflective construction of knowledge; currency; shared values and shared vision; collective learning; shared practices; resources, structures, and systems; relationships and climate; stimulating and participative leadership). We first linked the items to their a priori dimensions and tested these measurement models by conducting multilevel confirmatory factor analyses. Based on the results, average scores were calculated for each dimension.

We then conducted confirmatory multilevel factor analysis in which the dimensions were linked to their a priori capacities (personal, interpersonal, and organizational capacity) to determine whether the eight dimensions indeed underlay the three capacities, and if a similar structure could be found at both the

Table 1. Scales, Items, and Factor Loadings for the Dutch Capacity Building in Professional Learning Communities Questionnaire (CBPLC; Verbiest, 2008) ($N = 992$)

	Factor Loading	Residual
Personal capacity:		
Active and reflective construction of knowledge, adapted from Sackney et al., 2005 ($M = 3.12$, $SD = .38$, $\alpha = .80$):		
At our school . . .		
1. Teachers search for better ways of doing things	.68	.13
2. Teachers reflect on their professional practice	.71	.12
3. Teachers think about what is working and what's not	.77	.10
4. Teachers consider how their practices affect students	.66	.14
Currency, adapted from Sackney et al., 2005 ($M = 2.75$, $SD = .45$, $\alpha = .61$):		
At our school . . .		
1. Teachers make use of current educational research	.62	.22
2. Teachers inform themselves about good practices from other schools	.55	.29
3. Teachers inform themselves about good practices of their own colleagues	.64	.18
Interpersonal capacity:		
Shared values and shared vision, adapted from Huffman & Hipp, 2003; Sackney et al., 2005 ($M = 3.08$, $SD = .44$, $\alpha = .75$):		
At our school . . .		
1. A collaborative process exists for developing a shared vision among the staff	.66	.20
2. Decisions are made in alignment with the school's values and vision	.59	.19
3. Teachers take collective responsibility for student learning	.64	.21
4. Teachers share the same ideas about how to facilitate student learning	.67	.19
Collective learning, adapted from Huffman & Hipp, 2003 ($M = 3.03$, $SD = .42$, $\alpha = .76$):		
At our school . . .		
1. Teachers work together to acquire and apply new knowledge, skills, and strategies	.74	.13
2. Existing collegial relations among teachers reflect teachers' commitment to school improvement	.68	.18
3. Teachers collaborate to help students to solve problems	.59	.20
4. Teachers are engaged in a professional dialogue in which different ideas are examined	.60	.21
Shared practices, adapted from Huffman & Hipp, 2003 ($M = 2.60$, $SD = .45$, $\alpha = .67$):		
At our school . . .		
1. Teachers observe each other's lessons and give feedback on their teaching	.60	.34
2. Teachers informally share ideas and suggestions for improving student learning	.65	.15
3. Teachers discuss student work to improve their classroom practices	.63	.25
4. Teachers are involved in various forms of social network interaction in support for professional learning and school improvement	.60	.30
Organizational capacity:		
Resources, structures, and systems, adapted from Huffman & Hipp, 2003; Sackney et al., 2005 ($M = 2.87$, $SD = .41$, $\alpha = .72$):		
At our school . . .		
1. The school's schedule promotes collective learning and shared practice	.60	.25
2. There are sufficient possibilities for professional development	.66	.19
3. Appropriate technology and instructional materials are available	.52	.29
4. Teachers have easy access to professional literature	.48	.21
5. Communication systems promote a flow of information among the staff	.65	.22

Table 1. (Continued)

	Factor Loading	Residual
Relationships and climate, adapted from Huffman & Hipp, 2003 ($M = 2.99$, $SD = .42$, $\alpha = .70$):		
At our school . . .		
1. Caring relationships exist among staff and students that are built on trust and respect	.68	.19
2. Teachers dare to talk to each other about their professional practice	.60	.25
3. Initiatives to improve education are valued by colleagues	.70	.12
4. It is self-evident that teachers develop themselves professionally	.54	.23
Simulating and participative leadership, adapted from Geijsel et al., 2001, 2009; Mulford et al., 2004 ($M = 2.98$, $SD = .40$, $\alpha = .90$):		
At our school . . .		
1. The school leader takes the opinions of teachers into consideration when initiating actions that affect my work	.60	.21
2. The school leader is aware of the competence and expertise of teachers	.66	.18
3. The school leader takes care that teachers feel at home	.66	.20
4. The school leader is aware of teachers' personal needs	.64	.21
5. The school leader does not show favoritism toward individuals or groups	.61	.25
6. The school leader stimulates teachers to think about what they are doing for their students	.64	.19
7. The school leader encourages teachers to develop individual professional growth goals	.63	.22
8. The school leader encourages teachers to evaluate their practices and refine them when needed	.59	.23
9. The school leader is a source of new ideas for the professional learning of teachers	.66	.25
10. The school leader encourages teachers to try new things in line of their interests	.67	.19
11. The school leader delegates important responsibilities to teachers	.48	.28
12. The school leader involves teachers in innovations	.65	.24
13. The school leader facilitates effective communication among the staff	.69	.20
14. The school leader gives teachers opportunities to implement innovations	.66	.14

Note.—Scaling for all items was (1) disagree, (2) disagree more than agree, (3) agree more than disagree, (4) agree.

teacher level and school level. In addition, we tested two alternative models that both reflect a common research trend to conceptualize and measure the PLC as a single latent construct: (1) an alternative model in which the dimensions were linked to a single overarching latent construct (instead of three multilevel capacities) and (2) an alternative model in which each of the capacities and their underlying dimensions were linked to an overarching latent construct. We hypothesize that the proposed multidimensional, multilevel model would best fit the data from this study.

Model fit can be considered adequate when the CFI (comparative fit index) and TLI (Tucker-Lewis fit index) indices are above .95, when RMSEA (root mean square error of approximation) and SRMR (standardized root mean residual) are below .05, and when the chi-square value has a nonsignificant p -value (Hu & Bentler, 1999; Yuan & Bentler, 2000). However, the latter index (i.e., the robust Yuan-Bentler chi-square statistic) is considered least important as it is also related to sample size (larger samples are less likely to result in significant p -values). In addition, for the final model we report on the standardized factor loading coefficients.

Results

To examine the proposed multidimensional, multilevel model of PLCs within Dutch elementary schools, we started by linking all the items to their a priori dimensions and tested this measurement model by conducting multilevel confirmative factor analyses. These analyses encountered a number of problems. First, the amount of variance at the school level appeared very low for the items within each dimension. For the dimensions active and reflective construction of knowledge and currency, it ranged between 3% and 16%. For the dimensions shared values and vision, collective learning, and shared practices, between 7% and 30% (however, most items were close to 12%). And for the dimensions resources, structures, and systems; relationships and school climate; and stimulating and participative leadership, between 6% and 25%. This lack of variance in items also affected associations between items: some appeared to be almost perfectly correlated at the school level, resulting in convergence problems. These problems could not easily be resolved by deleting items or by allowing for correlations between measurement errors or between latent variables.

We therefore proceeded by conducting three separate confirmatory factor analyses for each of the three capacities at the teacher level. In addition, we tested whether model fit could be improved by correlating the separate dimensions. For each of the three capacities, it appeared that correlating the dimensions did improve model fit. Finally, we allowed correlations between measurement errors, provided they were between items of the same dimension. For each of the three capacities, adequate model fit was achieved in single-level models in which the items were linked to their a priori dimensions. The internal consistencies of the scales indicated that all dimensions had reasonable to good reliability. The parameter estimates (i.e., the factor loadings and residual variances), Cronbach's alpha, means, and standard deviations are presented in Table 1.

For personal capacity, model fit indicators for the dimensions currency and active and reflective construction of knowledge were adequate ($\chi^2(8) = 14.78, p = .06$; CFI = 1.00; TLI = .99; RMSEA = .029; SRMR = .014). The model explained between 30% and 59% of the variance in the items, and standardized factor loadings were between .55 and .77. As such, the two dimensions of currency and active and reflective construction of knowledge could be replicated by the seven items that were a priori assigned to these dimensions. Nevertheless, the two dimensions appeared to be strongly correlated, with the standardized correlation coefficient at .80.

For interpersonal capacity, model fit for the scales shared values and vision, collective learning, and shared practices was also adequate ($\chi^2(44) = 74.54, p < .01$; CFI = .99; TLI = .99; RMSEA = .026; and SRMR = .021), indicating that the 12 items seemed to reflect these three scales. The model explained between 35% and 54% of the variance in the items, and standardized factor loadings ranged between .59 and .74. The three dimensions within this capacity were found to be highly related; a particularly high (standardized) correlation was found between shared values and vision and collective learning (.93). Strong correlations were also found between collective learning and shared practices, and between shared values and vision and shared practices (.77 and .66, respectively).

Organizational capacity was assessed with the largest set of items, 23 in total, referring to the dimensions of resources, structures, and systems; relationships and climate; and stimulating and participative leadership. Again, satisfying model fit

could be achieved ($\chi^2(204) = 438.59, p < .001$; CFI = .97; TLI = .97; RMSEA = .034; and SRMR = .030). The model explained between 23% and 49% of the variance in the items, and standardized factor loadings ranged between .48 and .70. Reasonably strong correlations were found among the dimensions of resources, structures, and systems; relationships and climate; and stimulating and participative leadership (.59, .59, and .73, respectively).

We subsequently conducted confirmatory multilevel factor analysis to determine whether the three capacities could be represented by their eight underlying dimensions, and if a similar structure of capacities and underlying dimensions could be found at both the teacher and school levels. Intraclass correlations (ICCs) for the eight dimensions suggested that teachers' perceptions were not only idiosyncratic in nature, but that part of the variation in teacher perceptions could also be explained by differences between schools. The ICCs ranged between .17 for the active and reflective construction of knowledge scale (personal capacity) to .31 for stimulating and participative leadership (organizational capacity), thus indicating the need for a multilevel analysis of the data.

The final multilevel confirmatory factor analysis model showed adequate model fit ($\chi^2(35) = 55.98, p < .05$; CFI = .99; TLI = .99; RMSEA = .024; SRMR-within = .044, and SRMR-between = .016; BIC = -12,682.302). This model allowed for correlations between the capacities. It also allowed for correlation between measurement errors in the dimensions. Yet, only two of such correlations were found, namely between stimulating and participative leadership and resources, structures, and systems (at the teacher level) and between relationships and climate and stimulating and participative leadership (at the school level). Allowing for these correlations yielded a better model fit than a model without these correlations. As depicted in Table 2, the model explained scale variance reasonably well at the teacher level (between 26% and 65%) and very well at the school level (between 62% and 97%).

To challenge the aforementioned multilevel, multidimensional model of PLCs, we also tested two rival alternative models that were generated based on alternative assumptions about the nature of PLCs. The first alternative model tested whether all dimensions would load on a single latent factor, reflecting a common assumption that the PLC can be regarded as a single construct instead of consisting of three overarching multilevel capacities. This model was less parsimonious than the proposed multidimensional, multilevel model and provided a slightly worse model fit ($\chi^2(40) = 109.460, p < .001$; CFI = .98; TLI = .97; RMSEA = .042; SRMR-within =

Table 2. Variance Explained by the Final Multidimensional, Multilevel Model at the Teacher and School Level

Dimension	% Variance at Teacher Level	% Variance at School Level
Active and reflective construction of knowledge	59.5	95.4
Currency	44.0	79.6
Shared values and vision	59.5	76.6
Collective learning	65.3	97.1
Shared practices	34.8	76.4
Supportive sources, structures, and systems	26.1	79.8
Relationship and climate	54.3	96.7
Stimulating and participative leadership	28.8	62.0

.063, and SRMR-between = .025; BIC = -12,658.873). The second alternative model tested whether the dimensions and capacities would load onto a single latent factor, reflecting the assumption that a multidimensional, multilevel model would underlie a single overarching construct of the PLC. Again, this model proved to be less parsimonious and rendered worse model fit compared to the proposed multidimensional, multilevel model of PLCs ($\chi^2(38) = 182.563$, $p < .001$; CFI = .95; TLI = .93; RMSEA = .062; SRMR-within = .057, and SRMR-between = .040; BIC = -12,564.750).

In sum, our results indicate that PLCs can best be described by a model that includes multiple dimensions at multiple levels of capacity. The proposed multidimensional, multilevel model of PLCs indicates that the three capacities and eight dimensions can be distinguished empirically and are needed to describe the concept of PLCs, even though underlying dimensions may correlate considerably.

The final structural model is displayed in Figures 2 (teacher level) and 3 (school level). From these two figures, a number of observations can be made. First, strong positive (standardized) factor loadings are found at both levels, suggesting that the capacities are well represented by their underlying dimensions. At both the teacher and school levels, the dimension of active and reflective construction of knowledge contributes the strongest to personal capacity. The dimension collective learning was the largest contributor to interpersonal capacity, and the dimension relationship and climate added most to organizational capacity. As such, the multidimensional, multilevel model acted similarly at both levels of analysis. Second, high positive correlations existed between the three capacities, indicating that they are strongly interrelated. Third, the conceptual structure of the three capacities and their underlying dimensions emerged as equivalent at both the teacher and school levels. This means that shared perceptions within a school as well as individual differences between perceptions of teachers within a school can be represented by three strongly interconnected capacities that are in a similar fashion represented by the eight underlying dimensions. As such, this multidimensional, multilevel model of PLCs

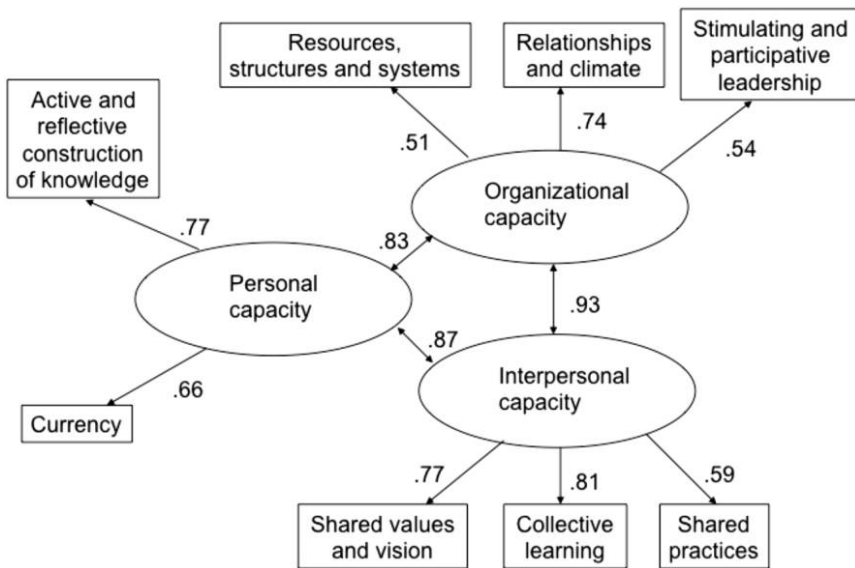


Figure 2. Structural model at the teacher level.

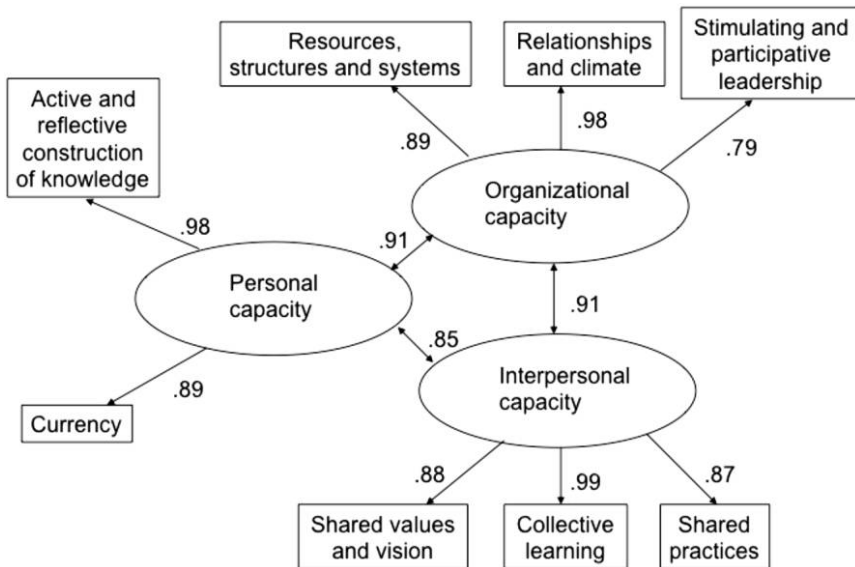


Figure 3. Structural model at the school level.

could be validated for the Dutch study setting and provides a nuanced understanding and measurement of this important and well-used concept.

Conclusions and Discussion

Researchers in the field of educational administration are increasingly using the concept of PLCs to understand how schools can build school-wide capacity to enhance professional learning. Although the concept of PLCs has received much attention, it also faces some conceptual and empirical challenges. At the conceptual level, studies identify and emphasize different dimensions and levels of capacity constituting the concept of PLCs, while empirical evidence for the claim that the PLC is a multidimensional, multilevel construct is scarce. In this study, we build on Mitchell and Sackney (2000) and Sackney et al.'s (2005) work and propose a model for the multidimensional, multilevel nature of the concept of PLCs, which we then tested using data from 992 teachers of 76 Dutch primary schools. We performed multilevel analyses to examine the proposed dimensions, capacities, and their interrelatedness at both the teacher and the school levels.

Our data offer support for the multidimensional, multilevel nature of the concept of PLCs. At both the teacher and school levels, the three distinguished capacities (personal, interpersonal, and organizational capacity) were well represented by their eight underlying dimensions. Until now, systematic research that tested the assumed interdependency of different dimensions and capacities of PLCs on both the teacher and school levels has been limited. We therefore also tested whether the sets of capacities and related dimensions of PLCs that emerged from the data were equivalent at both levels of analysis. Our results showed that shared teacher perceptions within a school (school-level perceptions of PLCs) as well as individual teachers' perceptions within a school (teacher-level perceptions of PLCs) can be represented by three strongly interconnected capacities (personal, interpersonal, and organizational capacity). Moreover, the way in which the eight aspects contributed to these

capacities was similar at both the teacher and the school level. Although the different capacities can be distinguished conceptually and empirically at both the teacher and school levels, they are strongly interrelated, thereby substantiating assumptions in the PLC literature (Mitchell & Sackney, 2000; Stoll et al, 2006). As such, our findings give credence to the multidimensional, multilevel nature of the concept of PLCs.

It is often assumed that the different capacities and dimensions as found in our study refer to an underlying latent construct such as community. Until now, this assumption has been subject to limited rigorous testing (Lomos, 2012). In our study, we examined this assumption by testing two alternative models that challenged our proposed multidimensional, multilevel model: one in which the dimensions were linked to one overarching latent construct directly, and one in which the dimensions and capacities were allowed to load on a single latent construct. The results indicated that these two models did not show a better fit than a multidimensional, multilevel model with three capacities and eight related dimensions without a single overarching latent factor. While we acknowledge that different study settings may result in variations in modeling PLCs, our findings give rise to the idea that it may be more accurate and more nuanced to describe the “community” in PLCs as a multidimensional construct instead of a single overarching concept. In addition to defining the concept of community by its underlying dimensions, it is also important to acknowledge the multiple levels at which PLCs are shaped (personal, interpersonal, organizational) as well as analyzed (teacher, school).

Although our findings offer an important contribution to a deeper understanding of the multidimensional, multilevel nature of the concept of PLCs, they do not inform us about ways to solve one of the key conceptual and empirical challenges that face PLCs—the notion of what constitutes “community.” As a more nuanced approach seems required, the debate about what dimensions underlie a community, as well as what constellation of dimensions will foster a strong community, will have to continue. While the dimensions proposed in this model seem to capture PLCs as reflected in current literature, other dimensions may prove to be equally useful. We therefore urge continued research to strengthen the understanding of the concept of PLCs in multiple settings and to extend its use in theory and practice. This study provides some direction as to where to look for answers. A first step may be for researchers to turn their attention to what constitutes community at multiple levels of a system (teacher, school, district). Scholars have suggested the weak elaboration of the notion of community as one of the main reasons for the underconceptualization of PLCs (Stoll et al., 2006; Westheimer, 1999). In our view, while researchers more and more attend to multiple levels when analyzing data, they often fail to specify the level at which they conceptualize their research question and concepts. This issue has been described before (e.g., Klein, Dansereau, & Hall, 1994), but until now has received limited attention. An interesting idea in this regard is the concept of *multilevel homology* (Chen & Bliese, 2002; Chen et al., 2002), which proposes that a concept may have different meanings and different relationships with other variables at multiple levels of analysis (e.g., aggregated self-efficacy may have a different meaning than collective efficacy). With the multilevel nature of educational data at the forefront of educational research, it is imperative that scholars attend to and examine such conceptual multilevel issues and their consequences for research and practice to help develop and conceptualize more complex, layered, and nuanced concepts such as PLCs.

On a related note, what continues to be needed are sound and valid theories about school-wide capacity to enhance teachers' individual and collective learning (Datnow, 2012; Finnigan & Daly, 2012). These theories could provide a lens through which we can better understand the complex interplay between capacities and dimensions and the interrelatedness of capacities at multiple levels of analysis. Recently, researchers have suggested that the theory of social capital would provide a valuable lens to describe collaborative structures such as professional communities (Coburn, Choi, & Mata, 2010; Moolenaar, Daly, & Slegers, 2011; Penuel, Riel, Krause, & Frank, 2009). Scholars seem to have overlooked what lies at the foundation of professional communities, such as teachers' social networks in schools (Daly, 2010; Daly & Finnigan, 2009). Social capital theory can be used to elaborate both the structural and relational dimensions of teachers' social interactions by examining teachers' social networks and trust, two important dimensions of PLCs (Coburn & Russell, 2008; Daly, Moolenaar, Bolivar, & Burke, 2010; Moolenaar & Slegers, 2010). In our view, social capital theory could provide a multilevel framework to reflect on the key dimensions of the concept of PLCs, such as shared values, trust, joint problem solving, and social interaction in social networks, the complex interplay between dimensions and capacities, and the interrelatedness of capacities at multiple levels of analysis.

A next step to unravel the complex multidimensional, multilevel concept of PLCs would be to conduct studies that employ mixed methods (Vescio et al., 2008). Future research that combines survey data with multiple case studies and longitudinal observational data may provide detailed and in-depth information about the dynamic relation between teachers' engagement in professional learning activities (personal capacity), the way this learning is embedded in interpersonal relations and networks (interpersonal capacity), the structural and cultural conditions that foster teachers' individual and collective learning (organizational capacity), and how these interrelated capacities change over time. Findings from these studies could also contribute to reducing the conceptual and empirical challenges that face the concept of PLCs and help us to capture the embedded nature of professional learning communities in and across schools more successfully.

Because empirical evidence for the claim that dimensions of PLCs affect student achievement is still accumulating (Lomos, Hofman, & Bosker, 2011; Vescio et al., 2008), additional research is necessary to empirically validate and test complex multilevel causal models that conceptualize the chain of variables that connect dimensions of PLCs with teacher and student outcomes. Such models may contribute to a better understanding of the impact of PLCs on the improvement of teachers' practices and student learning. In addition to using social capital theory and conducting studies using mixed methods, testing different multilevel models may also provide an important impetus for the early stage in which theories about effective PLCs find themselves at the moment (Stoll et al., 2006; Westheimer, 1999).

Limitations

While we believe that this study makes a unique contribution to the field of PLC research, we also acknowledge its limitations. From a methodological standpoint, there is still a considerable amount of variance unexplained by the models to describe PLCs. The results suggest that there is room for item improvement, given the high

correlations between items and correlations between measurement errors. An explanation could be that we used translated items from original questionnaires used in other countries, potentially resulting in a cultural bias. Additional methods may be used to cope with this bias, such as testing and validating the questionnaire in multiple settings, samples, and countries as the proposed model may be culturally sensitive. Also, using different items may lead to better distinctions between dimensions underlying the capacities. A way to improve our instrument may be to include strong items and subscales from earlier research, such as the Chicago study conducted by Bryk and colleagues (Bryk et al., 1999) and the ongoing work of the Consortium on Chicago School Research (CCSR). While we do not want to recommend yet another composite instrument, we acknowledge that our instrument can be refined in order to substantiate the measurement of the multidimensional, multilevel nature of PLCs.

Furthermore, the study is limited in that we tested our model in Dutch elementary schools, which are relatively small and often closed communities, with often relatively intense and long-term relationships among teachers and between teachers and students, and with little interaction between schools. Moreover, the teachers that participated in our study can be considered to be relatively experienced teachers. These sample issues may have influenced our findings. In addition, this study focused solely on school-based, within-school PLCs, while many elementary schools are now exploring ways to engage in PLC initiatives that cross school boundaries and build communities of teachers between, rather than within, schools (e.g., Katz & Earl, 2010; Muijs, West, & Ainscow, 2010). In order to strengthen the validity of our conceptual model, research into the multidimensional, multilevel nature of the concept of PLCs in a variety of settings (i.e., secondary education departments, vocational education, etc.) and across school boundaries is needed. Findings from such studies may contribute even further toward the conceptual clarity and focus needed to address the previously mentioned gaps in the literature.

Moreover, similar to many studies into school improvement and school effectiveness, we found little school-level variance. A larger amount of school-level variance would be helpful to analyze and understand the multidimensional, multilevel nature of the PLC and its impact on different outcomes more profoundly. Hence, future studies are advised to include larger and more heterogeneous samples. In sum, the nuanced insights on PLCs provided by this research may offer great opportunities to develop the multidimensional, multilevel concept of PLCs even further to help understand and capitalize on its potential for teacher and student learning.

Note

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