



Factors influencing teachers' professional development in networked professional learning communities



Rilana Prenger ^{a,*}, Cindy L. Poortman ^a, Adam Handelzalts ^b

^a University of Twente, Faculty of Behavioral, Management and Social Sciences, P.O. Box 217, 7500 AE Enschede, The Netherlands

^b Vrije Universiteit Amsterdam, Faculty of Psychology and Education, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

HIGHLIGHTS

- Professional boundaries play a significant role for networked PLCs.
- Motivation plays a key role at all levels of teachers' professional development.
- A shared goal, leadership and structured activities were contributing to teachers' satisfaction.
- A collective focus on student results was found significant for teachers' knowledge and skills.
- Limited social support hinders knowledge sharing within the school.

ARTICLE INFO

Article history:

Received 8 November 2016

Received in revised form

16 August 2017

Accepted 23 August 2017

Available online 5 September 2017

1. Introduction

To better prepare students for the workforce demands of the 21st century, teachers need to become 'high-level knowledge workers' who constantly learn professionally (Schleicher, 2012, p. 11). Teacher professional development is necessary to improve the quality of education, in order to ensure that all teachers are able to meet the needs of diverse student populations (e.g., Desimone, 2009; Kools & Stoll, 2016; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Vescio, Ross, & Adams, 2008; Van Veen, Zwart, Meirink, & Verloop, 2010). Research has shown that collaboration, a focus on student learning in teachers' daily practice and longer-term programs are important aspects of effective teacher professional development programs (PD). Teacher participation in professional learning communities (PLCs) is therefore considered to be

a promising way of providing professional development and supporting school improvement (Stoll, 2015). PLCs consist of teachers, and sometimes school leaders, working together with the aim of improving their students' education (Lomos, Hofman, & Bosker, 2011; Stoll et al., 2006). Teacher collaboration in PLCs can lead to increased teacher (e.g., Prenger, Poortman, & Handelzalts, 2016; Sammons, Mujtaba, Earl, & Gu, 2007) and student learning (e.g., Borko, 2004; Darling-Hammond, 2010; Stoll et al., 2006; Vescio et al., 2008).

Improvement in educational systems may even require a shift in emphasis from *within-to between-school* (and beyond-school) improvement (Chapman, 2014). Networks of schools can mobilize a wider range of resources and expertise than single schools; they may provide greater opportunities for both self-reflection and collective reflection on practice, and they may increase engagement with more challenging and interactive forms of professional learning (Lieberman & Grolnick, 1996; Lieberman, 2000). Therefore, PLCs *between* schools could further improve teachers' professional learning and hence, student achievement. Scholars, school leaders and policy-makers are therefore increasingly focused on between-school, 'networked' PLCs to improve education within schools and across school systems (Prenger et al., 2016). However, PLCs do not automatically lead to teacher professional learning and improved student learning: effects are often small or the results are mixed (Chapman & Muijs, 2014; Lomos et al., 2011). For *networked* PLCs, this is further complicated by their nature, which includes organizational, geographical and professional boundaries (Chapman, 2014).

Little systematic research is available about how networked PLCs work in terms of their key features (Chapman, 2014; Katz & Earl, 2010; Vescio et al., 2008). Considering the expectations for

* Corresponding author. Faculty of Behavioral, Management and Social Sciences, Institute for Teacher Training and Professional Development, P.O. Box 217, 7500 AE Enschede, The Netherlands.

E-mail addresses: h.c.prenger@utwente.nl (R. Prenger), c.l.poortman@utwente.nl (C.L. Poortman), a.handelzalts@vu.nl (A. Handelzalts).

teacher development and the potential of networked PLCs, greater insight into factors influencing the effectiveness of PLCs (e.g., Desimone, 2009) is necessary, for networked PLCs to be able to contribute effectively to teacher professional learning. The aim of this study, therefore, is to investigate the factors influencing teacher professional learning as a result of participation in networked PLCs.

2. Theoretical framework

Several studies have discussed the essential characteristics of (within-school) PLCs. Although different studies have presented slightly different factors or different focuses regarding these characteristics, in general the essential characteristics relate to:

2.1. A shared goal and focus on a concrete outcome

A shared goal, or sense of purpose, refers to the degree to which teachers agree with the school's mission and its operational principles (Lomos et al., 2011; Van Veen et al., 2010). For networked PLCs, this construct refers to shared acceptance of the PLC's specific goal. Having a fundamental and clear organizational purpose is known to be critical to the success of PLCs (Handelzalts, 2009; Katz & Earl, 2010) and has been found to have a direct impact on the effectiveness of PLCs (e.g., Andrews & Lewis, 2004; Lieberman & Grolnick, 1996).

2.2. Collective focus on student learning

A collective focus on student learning reflects the mutual commitment of teachers to students' success, and has been found to be an influential factor in the professional development that teachers experience following PLCs (Lomos et al., 2011). It is assumed to help teachers with sustaining commitment, to evoke peer pressure, and to ease isolation (Bolam, McMahon, Stoll, Thomas, & Wallace, 2005).

2.3. Reflective dialogue

Reflective dialogue includes conversations about serious educational issues or problems and refers to the extent to which teachers engage in professional dialogues about specific educational issues (Lomos et al., 2011). It refers to those conversations that encourage teachers to discuss their teaching practices and collaborate on how these practices can be improved. Professional reflection leads to extensive and continuing conversation among teachers about curriculum, instruction and student development (Vescio et al., 2008), which is required for knowledge creation (Katz & Earl, 2010).

2.4. Collaboration and active participation

Collaboration concerns the involvement of members in developmental activities with consequences for more than one person, and goes beyond superficial exchanges of help, support, or assistance (Louis, Kruse, & Associates, 1995). The participants must be engaged in opening up their beliefs and practices to investigation and debate (Katz & Earl, 2010). Feelings of interdependence are central to such collaboration. Better teaching practices are considered to be achieved with collaboration, linking collaborative activity and achievement of the shared purpose (Bolam et al., 2005).

2.5. Leadership

For the networked PLCs described in this study, leadership is

most evident for the external coach, but a leadership role for school principals may remain. Networked PLCs facilitate distributed leadership in schools and across the network, with many people with and without formal positions of authority providing a range of leadership functions, such as leading particular initiatives, participating in collaborative groups, supporting colleagues' learning and sharing knowledge with others (Harris & Jones, 2010; Katz & Earl, 2010; Stoll et al., 2006). This means that PLC members can be considered (informal) leaders themselves. Katz and Earl (2010) found that both formal and distributed leadership were associated with changes in pupil learning and thinking and the practice of teachers.

2.6. Structured and guided activities having a relation to practice

Garet, Porter, Desimone, Birman, and Yoon (2001) found that a core feature of teachers' professional development concerns the extent to which PD is perceived by teachers to be a part of a coherent program of teacher learning. Activities should have connections with goals and other activities, alignment with standards and assessments and should encourage communication with others (Handelzalts, 2009; Garet et al., 2001).

2.7. Trust

Engaging in learning can be risky, especially when working with colleagues. Teachers are unlikely to participate in classroom observation and feedback, mentoring partnerships, discussion about pedagogical issues, or curriculum innovation, unless they feel safe (Louis et al., 1995). Bryk, Camburn, and Seashore Louis (1999) found that working and reflecting together can build trust and strengthen relationships. Trust has been found to be related to changes in thinking and practice (Katz & Earl, 2010). For networked PLCs, trust may be an even more important factor, as members may not know each other, especially at the start of the PLC.

Additionally, Chapman (2014) has proposed that networked PLCs may be hindered by geographical, organizational and professional boundaries. Therefore, we also explore the influence of the following factors:

2.8. Facilitation of PLC participation (geographical and organizational boundaries)

Schools are bounded by structures when creating and developing a PLC (Stoll et al., 2006). These structures may be even more relevant for networked PLCs, as they address geographical and professional boundaries. First, time is an important precursor for attendance at meetings of both within- and between-schools PLCs (e.g., Louis et al., 1995; Van Veen et al., 2010). Timetabling and being able to cover classes for teachers who attend the networked PLC facilitate PLC participation. Also, duration of the time spent on the PD is important. However, research shows different guidelines, ranging from 14 to 80 h needed for a behavior change to occur among teachers (Van Veen et al., 2010). Second, size plays an important role in structuring a PLC's social dynamics, supporting better communication flow and greater face-to-face interaction (Bryk et al., 1999). Third, location can be even more important for networked PLCs, as the geographical distances between participants are presumably larger (e.g., costs and travel time). Lastly, team characteristics could be influential for teachers' professional development resulting from PLC participation (e.g., heterogeneity).

2.9. Stakeholder support: school (principal) and colleagues (professional boundary)

The amount and quality of external support for any serious improvement effect is critical for accomplishing change (Stoll et al., 2006). For example, Voogt et al. (2011) reported that a lack of support from the school hindered work in teacher design teams. For networked PLCs, external support may be even more important, as the PD activities take place with teachers from different schools. The opportunities to reflect on PLC activities and their acquired knowledge might therefore be more limited. Moreover, knowledge sharing within the participants' own school could be hindered due to a lack of social support from the school leader, or colleagues.

2.10. Individual prior knowledge and motivation (professional boundaries)

Prior knowledge and motivation are generally accepted factors in both individual and collective learning, and should therefore be included as influential factors in the PLC process. In the case of *networked* PLCs, individual prior knowledge might be a professional boundary, as the knowledge base could vary even more between individuals from different schools. Individual prior knowledge refers to the teacher's knowledge, skills and experiences at the start of the PLC. A professional boundary could also be present in terms of motivation to participate, which might vary even more between participants from different schools, with different cultures and leadership. Motivation can be defined as the process that initiates, guides, and maintains goal-oriented behaviors. According to Self-Determination Theory (SDT) (Ryan & Deci, 2000), teachers may perceive themselves as competent, but some may perform their work tasks because they personally grasp the value of their work, whereas others engage in these work tasks because of external pressures or benefits associated with the work (Fernet, Senécal, Guay, Marsh, & Dowson, 2008).

A central characteristic of complex systems is the interdependence of the constituent elements, with each one being connected to all the others. A change in any one invites changes in the rest (Sutherland & Katz, 2005). For example, it can be assumed that when participants experience a higher level of trust in the PLC, their collaboration will benefit from this. This means that the various characteristics are intertwined and do not operate separately (e.g., Bolam et al., 2005).

3. Effects of networked PLCs

Teacher PD efforts generally share the goal of changing teachers' behavior, knowledge and attitude, with the ultimate goal of improving student achievement (e.g., Desimone, 2009). For this study we applied the framework outlined by Desimone, Smith, and Phillips (2013), in which sequential levels of teachers' professional development are described. At the first level, participants must feel satisfied with the process and the results of the PLC. Then in the second level, participants can acquire knowledge and skills, and changes in attitude due to professional learning. Level three concerns changes in behavior following PLC participation, that is, the application of the knowledge, skills (and attitude) in their own practice. Ultimately, over the longer term, results for student learning can occur, due to the changes in learning and behavior at the teacher level. In a previous study, Prenger et al. (2016) found moderately positive effects for all three levels of professional development effects.

4. The context of the project

The Dutch Ministry of Education has provided support for the four year project 'Pilots for the development of PLCs', which is aimed at setting up, guiding and researching PLCs made up of teachers from different schools across the Netherlands. In total, 23 PLCs from different regions in the Netherlands are participating. This study focuses on the factors that influence professional development in the first year of PLC participation. The criteria were that the PLCs should:

- include teachers from *different* schools with a *shared* teaching subject
- consist of a mix of teachers who graduated from higher professional and from university teacher education
- work on a specific product or approach as the main outcome of the PLC
- meet regularly (at least once a month) for at least one year
- be guided by at least one teaching subject-expert in the area of research, curriculum design or pedagogical approach (the external coach).

The goals or subject of the PLCs could be freely determined. The goals of the 23 PLCs can be categorized according to three main themes:

- Addressing teachers' professional attitude, for example, performing research on educational issues (4 PLCs).
- Development of new lesson material, for example, new lesson material for ICT in the classroom or for reading (16 PLCs).
- A combination of addressing teachers' professional attitude and the development of lesson material, by developing new lessons through a lesson study approach (3 PLCs).

Each PLC had their own specific goals and intended outcomes. These ranged from 'promoting a critical and reflective attitude in teachers' to 'developing new lesson material for the science subjects'.

In this study we focused on *networked* PLCs with no predefined format regarding the essential characteristics as described in the literature. The question is, therefore, to what extent features such as shared goal, participation and collaboration were realized, and how they related to the effects of the PLC. The research question addressed in this study is:

How do the factors and preconditions for effective PLCs presented above influence the three sequential levels of teachers' professional development in networked PLCs, that is.

- Teacher satisfaction with the PLC process;
- Changes in knowledge, skills and attitude;
- Application of knowledge and skills and product or approach?

5. Research design and method

5.1. Mixed-methods approach

According to Lomos et al. (2011), studies of PLCs during the last decade were based on either qualitative or quantitative designs. To understand teacher professional learning, such learning must be studied in multiple contexts, and in relation to both the individuals and the social systems in which they are participants (Borko, 2004). To connect the learning and behavior of teachers at the different levels of professional development and relate the outcomes to influential factors and preconditions, we have used a mixed-

methods design (Prenger et al., 2016). In this study, we combined quantitative survey research (teacher respondents) with qualitative data (external coaches' logs) from all 23 PLCs and qualitative data from case studies of a selection of five of the 23 PLCs (teacher and external coaches respondents). To report outcomes regarding teachers' professional development at the level of satisfaction, knowledge and skills, attitude and behavior for a large number of teachers participating in 23 PLCs and to relate influential factors and preconditions to these effects, we made use of survey research. However, the PLCs in this study varied in terms of main goals, total number of participants, duration and region. Therefore, five PLCs representing five different regions in the Netherlands were studied more intensively as case studies (interviews and observations) to additionally explore the mechanisms underlying the progress and outcomes of specific PLCs in greater detail. Lastly, the external coaches from all 23 PLCs were asked to keep a log, in which additional information could be collected from the external coaches' perspective.

5.2. Respondents

In this study, teachers from 23 PLCs from 11 different regions in the Netherlands participated in the survey ($n = 276$ teachers in total for the quantitative survey results). For the qualitative interviews, three teachers per case study participated (15 teachers in total). Teachers were the main respondents for this study, as we were mainly interested in the factors influencing their professional development. For the qualitative logs, interviews and observations, 33 external PLC coaches were also involved as respondents, both for triangulation purposes and for detailed examination of effects and the influential factors. The university or higher professional education institution that applied for a PLC within the project appointed the coaches based on their expertise. Of these coaches, 23 were working at a university teacher training program and the other coaches worked in a teacher training program at a higher professional education institution. The coaches are teacher educators.

5.3. Instruments

Measurements addressing each specific factor of the overarching research question are described below. Table 1 provides an overview of the aspects measured per instrument.

Table 1
Instruments used for data collection.

	Teacher questionnaire ^a	External coach log ^a	Case study interviews ^b	Case study observations ^b
Shared goal	x	x	x	x
Collective focus	x		x	
Reflective dialogue	x		x	x
Collaboration	x	x	x	x
Leadership	x		x	
Structured activities	x		x	x
Trust	x		x	
Prior knowledge	x		x	
Motivation	x		x	
Support	x		x	
Facilitation	x	x	x	
<i>Levels of professional development</i>				
Satisfaction	x	x	x	x
Knowledge, skills and attitude	x	x	x	x
Application	x	x	x	x

^a 23 PLCs.

^b 5 PLCs.

5.3.1. Questionnaire

A questionnaire, consisting of 83 items, was developed to quantitatively assess the influential factors and effects of the PLCs in this project. Considering effects, it focused on participants' perceptions of the extent to which effects at the sequential levels of professional development were realized: satisfaction, knowledge, skills and attitude, and application (Prenger et al., 2016). Information about the subscales measuring these different levels is shown in Table 2. The questionnaire was administered to participants after approximately 12 months of PLC participation.

5.4. Factors and preconditions

Considering factors and preconditions, the questionnaire included the following scales:

5.4.1. Shared goal and focus on a concrete outcome

Regarding shared goal, two items were included in the questionnaire asking the extent to which goals among participants are perceived as being shared (e.g., 'Within this PLC, everyone is oriented towards the same goal'). In addition, a validated scale consisting of three items measuring shared goals in an organization from a questionnaire by Chow and Chan (2008) was included (e.g., 'The PLC members and I are always enthusiastic about pursuing the collective goals and missions of the whole PLC').

5.4.2. Collective focus on student learning

For collective focus on student learning, we included three items asking to what extent there is a perceived collective focus on student learning among participants (e.g., 'Every meeting, we explicitly discuss the improvement of student learning results').

5.4.3. Reflective dialogue

Regarding reflective dialogue, four items were included based on literature referring to the extent to which teachers engage in professional dialogues about specific educational issues (e.g., 'In this PLC, we reflect on relevant issues').

5.4.4. Collaboration and active participation

For collaboration and active participation, items were based on the TeamWork Quality construct (TWQ) (Hoegl & Gemuenden, 2001). The scale in the questionnaire for the present study measured four relevant concepts: communication, mutual support, effort, and cohesion. The collaboration scale consisted of nine items, measuring the extent to which members are involved in

Table 2
Reliability analyses for the scales assessing the levels of professional development.

Level	Items	α	Sample items
Satisfaction (Level 1)	8	0.87	'Our PLC makes efficient use of the meetings'
Knowledge and skills (Level 2)	6	0.81	'Since PLC participation, I have acquired skills to improve my teaching practice'
Attitude (Level 2)	5	0.88	'Since PLC participation, I enjoy the subject more compared to before'
Application-research activities (Level 3)	4	0.81	'Since PLC participation, I have improved my research activities'
Application-teaching practice (Level 3)	5	0.87	'Since PLC participation, I have improved my teaching practice'

Note. Application-teaching practice loaded on the knowledge and skills factor and was extracted from this scale based on theoretical considerations.

(activities of) the PLC (e.g., 'Within the PLC, members communicate directly and personally with each other' and 'The members of the PLC felt proud to be part of the PLC').

5.4.5. Leadership

Regarding leadership, two separate categories were defined: the external coach and, if applicable, the PLC members (shared leadership). Items consisted of nine statements based on the questionnaire for teacher design teams developed by Binkhorst, Handelzalts, Poortman, and van Joolinge (2015) (e.g., 'The support of the external coach contributes to the results of the PLC' and 'The leading role of PLC members contributes to the structure of the PLC').

5.4.6. Structured and guided activities with a relation to practice

For structured and guided activities, seven items were formulated based on the literature. The items refer to the extent to which activities are relevant for practice, are structured, and lead to discussions and reflections within the PLC (e.g., 'The PLC activities are relevant to my own practice' and 'The PLC activities have a common theme').

5.4.7. Trust

The concept of trust was measured based on the validated questionnaire by Costa and Anderson (2011). They defined trust as consisting of four distinct but related indicators, namely, the propensity to trust (general willingness to trust others) and perceived trustworthiness, which lead to (reflective) indicators, that is, behaviors of cooperation and monitoring between team members. The scale in the questionnaire for the present study consisted of 16 items measuring distinct but related and relevant indicators, that is, the propensity to trust (e.g., 'People in this team help and support each other'), perceived trustworthiness (e.g., 'In this PLC, people can rely on each other'), and behaviors of cooperation (e.g., 'Some people hold back relevant information in this team').

5.4.8. Individual prior knowledge

Three items were included regarding the extent to which participants feel they had sufficient prior knowledge of the PLC's specific subject to successfully participate in the PLC (e.g., 'Regarding the PLC's subject, I feel I had sufficient prior knowledge at the start of the PLC').

5.4.9. Motivation

Motivation for PLC participation was measured based on the validated Work Tasks Motivation Scale for teachers (Fernet et al., 2008). The current scale consisted of seven items measuring two different types of motivation: intrinsic motivation (e.g., 'I participate in the PLC, because I like doing this'), and external motivation (e.g., 'I participate in the PLC, because my school demands it').

5.4.10. Support

Regarding support, we included six items referring to the perceived support for the teachers' PLC participation. Support from both the school (principal) (based on Binkhorst et al., 2015) and

colleagues were measured (e.g., 'My school (principal) supports my PLC participation' and 'My colleagues show interest in the process and outcomes of the PLC').

5.4.11. Facilitation of PLC participation

Facilitation (eight items) was measured in terms of time spent per month on the PLC, frequency of meetings, location and facilitation of time by the school (e.g., free time in schedule, or make sure classes are covered). Additionally, four statements about group composition were included in the questionnaire.

5.5. Validity and reliability questionnaire

To optimize the face and content validity of the questionnaire, the instrument was piloted on a small scale. The questionnaire was discussed with relevant researchers (2), experts and teachers (2). Based on their comments, adjustments to the questionnaire were made to optimize face and content validity.

5.5.1. Factors influencing professional development

A principal axis factor analysis was conducted on the intended scales for the different factors with varimax rotation to assess construct validity (Appendix A). The Kaiser-Meyer-Okin measure verified the sampling adequacy for the analysis ($KMO = 0.84$). An initial analysis was run to obtain eigenvalues for each factor in the data. Twelve factors had eigenvalues over Kaiser's criterion of 1 and in combination explained 61.39% of the variance. The items that clustered on the same factor suggest that factor 1 represents trust, factor 2 represents leadership by external coach, factor 3 represents intrinsic motivation, factor 4 represents collaboration, factor 5 represents support from school, factor 6 represents external motivation, factor 7 represents collective focus on student learning, factor 8 represents reflective dialogue, factor 9 represents shared goal, factor 10 represents support from colleagues, factor 11 represents structured activities and factor 12 represents prior knowledge. Multiple items had loadings less than 0.40, and were deleted for further analysis. Reliability of the scales was sufficient to good, except for prior knowledge (Table 3). Reliability and factor analyses for the effect measures of PD were described elsewhere (Prenger et al., 2016).

5.6. External coach logs

Complementary to the questionnaires and case study interviews, we collected information about preconditions and influential factors with a log, to be completed by the external coaches from all 23 PLCs after each PLC meeting. These logs served to follow gradual developments over time, from meeting to meeting. Beyond providing information about several organizational aspects of the meeting (time investment, frequency and number of participants), the log focused on the following subjects: the purpose and activities of the meeting and what it produced; what went well during the meeting and what could be improved; how collaboration took place; what was agreed upon for the next meeting; and any other

Table 3
Results of reliability and factor analysis.

Factors	Items	α	Example items
Trust	15	0.94	'In this PLC we are truly interested in each other'
Leadership external coach	6	0.93	'The support of the external coach contributes to the structure of the PLC'
Intrinsic motivation	3	0.87	'I think PLC participation is interesting'
Collaboration	5	0.83	'The participants are proud to be part of the PLC'
External motivation	3	0.83	'I would feel guilty if I didn't participate'
Collective focus	3	0.81	'In our PLC, the focus is to promote student results'
Reflective dialogue	3	0.88	'In this PLC we discuss the present and desired situations for relevant topics'
Shared goal	4	0.84	'In this PLC everybody shares ambitions and goals'
Support school	4	0.83	'My school supports my PLC participation'
Support colleagues	2	0.75 ^a	'My colleagues are interested in the PLC's proceedings'
Structured activities	4	0.87	'The PLC activities are structured'
Prior knowledge	3	0.45 ^b	'My prior knowledge on the subject was sufficient at the start of the PLC'

^a For this scale, a Pearson correlation was calculated.

^b The factor prior knowledge was removed from further analyses due to the low reliability score.

reflections by the external coach.

5.7. Case studies

The researchers visited the five PLCs selected for the case studies at approximately the end of the first year. The five PLCs represented five different regions in the Netherlands. We selected one PLC concerning teachers' professional attitude, one that focused on the Lesson Study approach and three in which the focus was on the development of lesson material. This reflects the (number of) PLCs focused on each of these categories.

5.7.1. Observations

The researchers attended a PLC meeting to observe the process, for which purpose an observation form was used. This observation form contained items regarding the number of participants, the amount of time spent on the meeting, the specific goal of the meeting, the activities, the products, the collaboration, and an evaluation and assignment of tasks to be completed before the next meeting. Additional remarks could also be made on the observation form.

5.7.2. Interviews

Data about the factors relating to the process of professional development were collected by means of audiotaped case study interviews of three teachers and an external coach for five PLCs. The duration of the interviews was 30 min, on average. The interviews were conducted by the researchers using an interview scheme. Interviews were held after the observation of the meeting. Open-ended questions regarding perceptions of the factors assumed to contribute to professional development were asked of both the teachers and external coaches.

5.8. Analyses

To analyze the factors related to and influencing professional development from the questionnaire, first, we performed descriptive analyses of the influential factors described in the literature. Second, correlational and regression analyses were conducted to analyze the significant contribution of the factors to the different levels of professional development. Regression analyses were performed for the factors that were significantly correlated to the different levels of professional development ($p < 0.05$). We conducted four different multivariate regression analyses, for satisfaction, knowledge and skills, attitude, and application in teaching practice (no significant correlations were found for application to participants' research activities). As prior knowledge was not found

reliable as a factor, it was ignored for regression analyses. For correlational analyses, we included two items referring to prior knowledge: prior knowledge and group composition (background). All of these analyses were performed using SPSS 22.0. Third, interviews and observations from the case studies and the external coaches' logs were qualitatively analyzed.

The data may be regarded as having a nested structure (teachers are nested within PLCs), which suggests that multilevel analyses are needed (Hox, 2002). However, the group sizes for some PLCs were too limited to perform multilevel analyses. Therefore, multivariate regression analyses were done. To draw conclusions based on regression analysis, several assumptions must be met (Field, 2009), which were all checked and met for the analyses.

5.9. Interviews, external coaches logs, observations

The interview data were transcribed verbatim based on the audiotapes. We used the program ATLAS.ti for coding and comparing the transcripts of the interviews, external coaches' logs and observations from different respondents within and across cases. A coding scheme was developed by the researchers, consistent with the theoretical framework. Codes were, for example, satisfaction, shared goal, and motivation. Three researchers independently coded approximately 10% of the same transcripts. The inter-rater agreement was substantial, with a Cohen's Kappa of 0.65 (Landis & Koch, 1977). After consensus was reached among the researchers, the remainder of the data were coded and analyzed by one of the researchers. Each relevant transcript was coded for responses regarding the factors within the theoretical framework. The results were compared and summarized per category for the respondents and logs by PLC, and overall, with a distinction being made between the perspectives of the teachers and the external coaches, and were used to illustrate the quantitative results.

6. Results

6.1. Respondents

Characteristics for the respondents are shown in Table 4. The survey was sent to all the teachers participating in all 23 PLCs, a total of 276 teachers. A total of 151 teachers (response rate 54.7%) representing 21 PLCs (91.3%) participated in the survey. The reported attendance rate varied from 67.5% to 95.2%. There was one PLC that reported an attendance rate of 114%, because participants invited colleagues to attend the PLC.

Table 4
Characteristics for teachers of 21 PLCs individually responding to the survey.

Teachers/School locations		151/101	
Themes	Lesson material	64%	
	Lesson Study	15%	
	Research skills	21%	
Gender	Male	49.6%	
	Teaching in secondary education	Upper classes	27.9%
	Lower classes	19.9%	
Main subjects	Both	52.2%	
	Physics	18.1%	
	Geometry	15.2%	
Teachers' academic level	Mathematics	13.0%	
	University	58.3%	
	Higher professional education	41.7%	
Teaching experience (years)	$m = 16.12$ ($sd = 10.48$)		
Time spent on PLC per month (hours)	$m = 9.37$ ($sd = 4.68$), median = 10		
Time provided by school per month (hours)	$m = 8.50$ ($sd = 15.91$), median = 5		
Members per PLC	Median = 10 (min = 3, max = 22)		
Number of colleagues participating	Median = 1 (min = 0, max = 10)		
Number of missed meetings	Median = 1 (min = 0, max = 7)		

6.2. Descriptive analyses

6.2.1. Shared goal

6.2.1.1. Questionnaire. Results from the questionnaire showed a mean of $m = 3.54$ ($sd = 0.71$) for the perception of a shared goal among participants. This means participants responded on average between 'neutral' and 'agree' on a 5-point Likert scale (1 = totally disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = totally agree) on statements such as: 'In this PLC, everybody shares the same goal' and 'In this PLC, we agree on what is important'.

6.2.1.2. Logs, interviews and observations. The data from the logs and interviews underlined this finding and implied that most teachers were generally in agreement concerning the goal of the PLC. However, there were inconsistencies between teachers. Some teachers reported that the ultimate goal of the PLC was sometimes hard to formulate and not clear. Starting the PLC without a clear goal was reported several times, in the interviews as well as in the logs, especially for those PLCs who did not work with an approach such as Lesson Study, or a structured preset plan. There were also members who came to the PLC with their own personal goals, which made the formulation of a shared goal more difficult. One participant stated in an interview: 'We were talking about all kinds of interesting things, but what will you say the next time? Or what are you going to say to your colleagues tomorrow? That is something I cannot say.'

6.2.2. Collective focus on student learning

6.2.2.1. Questionnaire. Results showed that the mean for collective focus on student learning among all participants was $m = 3.79$ ($sd = 0.70$). This implies that participants responded between 'neutral' and 'agree' on items such as: 'In our PLC, the intended goal is to improve student results'.

6.2.2.2. Logs, interviews and observations. Multiple teachers reported that they participated in the PLC for the students, and that teachers experienced the focus on student learning positively during the meetings. For example, a participant stated in an interview: 'Okay, it could be that it appears that we think something is very clear, but that the children have no idea, and that you think, oh wait a minute (...) for the children it has to be a little bit different than for us.'

6.2.3. Reflective dialogue

6.2.3.1. Questionnaire. Results showed that the mean for the perception of reflective dialogue among all participants was $m = 3.91$ ($sd = 0.62$). This means that on average, participants agreed on items such as: 'In this PLC, we reflect on relevant subjects' and 'In this PLC we draw conclusions from discussion of relevant subjects'.

6.2.3.2. Logs, interviews and observations. The interview results varied on the perception of reflective dialogue. One teacher indicated in the interviews that he thought the discussions were simplistic, and that participants should be more critical towards each other, as illustrated by the following quote: 'Look, they keep things back. They are still very careful'. Most respondents, however, reported they thought the discussions were interesting, constructive and subject-specific. The external coaches reported differently on the reflective dialogue. Some were satisfied, but one external coach reported, for example, that dialogues concerned issues other than the subject they were currently working on and were not constructive. It was also reported that dialogue was hindered by the fact that teachers were from different (subject) fields. In the logs, external coaches often reported discussions that consisted of the exchange of experiences, talking about insecurities and doubts, providing critical feedback, giving different opinions, tips, remarks, constructive critiques and good listening. These discussions were prompted by the external coach, by presentations, literature or other materials. The logs and interviews did not give information about the degree of reflectiveness of these discussions.

6.2.4. Collaboration and active participation

6.2.4.1. Questionnaire. Results showed that the mean for collaboration and active participation was $m = 3.40$ ($sd = 0.60$) among all participants. This indicates that participants responded between 'neutral' and 'agree' on statements such as: 'In this PLC all participants feel involved' and 'In this PLC participants disagree about the effort participants have to spend on the PLC'. On average, participants had missed 1.24 meetings ($sd = 1.14$, mode = 1).

6.2.4.2. Logs, interviews and observations. In the interviews, collaboration was described as a collegial exchange in which people got to know how everything works at other schools, in which ideas, materials and methods were exchanged, there were discussions, and people were interested in each other's results. Most teachers and external coaches reported that teachers collaborated well

during meetings. On the other hand, some teachers reported they did not collaborate because of the difference in (subject) field. The most often mentioned suggestions for improvement concerning collaboration were to provide multiple opportunities for contact and getting to know each other better. A hindering factor for collaboration was teachers' absence during meetings and the lack of preparation. Participants and external coaches reported that active participation between meetings was often hindered by a high work load and lack of time, however this differed between participants within, and between PLCs. This led to irritation among the more active PLC members, as they felt they were depended on by others in the PLC.

6.2.5. Leadership

6.2.5.1. Questionnaire. Results from the questionnaire showed that the mean for perceived leadership by the external coach was $m = 4.01$ ($sd = 0.65$). This means that participants agreed to statements such as: *'The external coaches' support consists of an active role during meetings'* and *'The external coaches' support leads to useful tips and tutorials'*. Additionally, the questionnaire asked about shared leadership by one or more participants. For perceived leadership by participants, the mean was 3.89 ($sd = 0.70$, $n = 66$). This means that on average, participants responded between 'neutral' and 'agree' for statements such as: *'The leading role of these participants contributes to the PLC results'*.

6.2.5.2. Logs, interviews and observations. The logs and interviews revealed that leadership by the external coach consisted of prompting discussions, motivating participants, inviting external speakers, preparing and evaluating meetings, providing feedback, networking, time management of meetings and the PLC-trajectory, and providing materials, input and tips. Generally, external coaches were perceived by the participants as group-oriented and enthusiastic. One participant reported, for example: *'They are present, but not obtrusive. They redirect, ask questions, let us think, I think that is important'*. For two other case studies, teachers reported that they would like more structure provided by the external coach, as especially in the beginning, the meetings were not constructive for them.

The varying responses of the teachers were confirmed by the coaches. For example, in one case study the external coach reported that leadership was difficult because of the different fields participants were from, which hindered the formulation of a clear goal and structure. And in another case study, the coaches reported to be enthusiastic and they were finding their role. Regarding shared leadership by participants, it was noted that there were some teachers with substantive input. One external coach reported intending to address the expertise of several participants more. Perceived leadership by the school leader concerning the PLC was rarely mentioned in the logs and the interviews.

6.2.6. Structured activities

6.2.6.1. Questionnaire. Results showed a mean of $m = 3.74$ ($sd = 0.63$) for the perception of PLC activities as being structured and relevant. This means that on average, participants responded between 'neutral' and 'agree' for statements such as *'The activities of the PLC are structured'* and *'The activities of the PLC are consistent with the PLC goal'*.

6.2.6.2. Logs, interviews and observations. In general, teachers reported that they were satisfied about the (structure) of the activities, and reported they could give input for ideas and desires. In the logs, external coaches reported a constructive structure of activities during and between meetings, in which several sub-goals were addressed per activity. Examples of activities within meetings were

formulating goals, the exchange of experiences, or working in groups on assignments or products. In the logs, as well as the interviews, homework assignments were reported being given to the participants. These activities between meetings consisted of, for example, the application of the products or lessons that had been developed, work on their research or reading each other's work and literature. One participant reported, for example: *'Yes and then we receive homework that consists of looking at the data files on your own. And then, subsequently, giving our own research at that point more content.'*

6.2.7. Trust

6.2.7.1. Questionnaire. Results from the questionnaire showed that the mean for the perception of trust within the PLC was $m = 3.88$ ($sd = 0.49$). This means that participants responded between 'neutral' and 'agree', on average, to statements such as: *'In this PLC people can trust each other'* and *'In this PLC suggestions and contributions from each other are respected'*.

6.2.7.2. Logs, interviews and observations. The logs and the interviews underlined this result: in general there was a safe, constructive, respectful and open atmosphere in the groups, reported by both the teachers and the external coaches. An external coach reported, for example: *'There is respect for each other. The opportunity [...] to give your opinion and sharing ideas is present. There is laughter, but people also say things like, well, that is not what I want, I want something different, so, I feel like there is a very positive atmosphere, a safe atmosphere.'* However, the reported variable group composition (facilitation) did not contribute to the perception of trust. Working in small groups stimulated discussion and trust as illustrated by the following participant in an interview: *'But I think that you get much more discussion in smaller groups and people say a lot more. But that is more protected, you notice. And as soon as it is in the larger group, then you see that people tend to be more quiet. And do not participate anymore.'*

6.2.8. Motivation

6.2.8.1. Questionnaire. Motivation was divided into two categories: intrinsic and extrinsic motivation. The mean for intrinsic motivation among all participants was $m = 4.13$ ($sd = 0.68$) on a 5-point Likert scale. For extrinsic motivation, the mean was lower ($m = 2.46$; $sd = 0.93$). This means that participants responded between 'not agree' and 'neutral' to statements such as: *'I would feel bad if I did not participate'* and *'To do my work properly, I should participate'*. This indicates that teachers were generally more intrinsically motivated to participate in the PLC, than they were extrinsically motivated.

6.2.8.2. Logs, interviews and observations. The logs and the interviews underlined these findings and showed that multiple teachers participated because they were interested in the subject or the concept of PLC, or because they intended to build a professional network. Additionally, teachers participated for their own development, but also for the students, as illustrated by a teacher in one of the interviews: *'I think it is important [.....] For my own development, as a teacher. But also for my students, that they are approached as individuals by teachers, and not just as a group of 32'*. However, some participants were asked to join the PLC by the school leader. This was illustrated by the following participant: *'I was asked to participate by my executive. So I did not choose to participate, well, I did choose to, but more like 'This is something for you', she said, [...] I think you will like this and I think the school will profit from this. What do you think about this?' Then, I read about it and I think, I think well, this triggers me, this is interesting for me.'*

6.2.9. Prior knowledge

6.2.9.1. Questionnaire. Prior knowledge was reflected by one item, asking to what extent participants feel that they had sufficient knowledge of the academic content area being addressed at the start of the PLC. The mean was $m = 3.18$ ($sd = 1.04$), meaning that on average, participants responded neutrally to this statement. The greatest percentage of participants agreed with this item (39.6%); however, 26.4% reacted neutrally to this item and 21.5% disagreed.

Additionally, the group composition in terms of background varied in the PLCs. The results from the questionnaire showed a mean of $m = 4.01$ ($sd = 0.63$) for the perception of a varied group composition, in terms of background. This means that participants on average responded 'agree' on the statement: 'Our PLC consists of a varied group of people'.

6.2.9.2. Logs, interviews and observations. The logs and interviews underlined the varying prior knowledge of participants. External coaches and teachers reported that there were teachers who did not know much about the subject being addressed, but there were also experts among participants within the PLC. For example, one teacher stated: 'Actually, I knew more from my training from last year than [...] that I heard some new things'.

Considering group composition, the interviews with participants showed that the participants' varied backgrounds were perceived positively, as well as negatively. For example, the following quote represented a positive perception: 'There is a lot of difference in background level, but that is also nice, and I think that a varying composition isn't a limitation'. Others were less positive, as they felt limited by, for example, the differences between teachers in upper and lower classes and the different learning goals and materials they apply.

6.2.10. Support

6.2.10.1. Questionnaire. The factor analysis indicated that 'support' can be divided into two separate constructs: support from school (administration) and support from colleagues (at the participant's own school). Results showed that the mean for support from the school administration was $m = 3.51$ ($sd = 0.81$). This means that participants responded between 'neutral' and 'agree' (5-point Likert scale) to statements such as: 'My school administration supports my PLC participation' and 'My school administration makes me feel supported in my PLC participation'. The mean for support from colleagues was $m = 2.86$ ($sd = 0.92$). This means that participants responded between 'disagree' and 'neutral' to statements such as: 'My colleagues stimulate my PLC participation'. Furthermore, results from the questionnaire showed that on average, 1 or 2 colleagues at their own school were participating in the PLC as well.

6.2.10.2. Logs, interviews and observations. The logs and interviews showed that both formally, and informally, participants had little contact concerning the PLC with the school (administration) and their colleagues. One participant reported regarding colleagues' support, for example: 'The PLC is still far removed from them [...] However, if someone comes to me and asks me how to abstract essentials from the text, then I say, oh in the PLC we did something nice [...] And then I try to make people enthusiastic in that way'. Another participant reported: 'It is more that I tell what I do and what happened [...] That they know that I am going to teach a research lesson for example [...] I think that when you ask a colleague of mine, what is X doing in the PLC, that they can't give an answer to that.' On the other hand, several teachers reported that they were aware of the importance of contacts and exchange of information with the school and colleagues. Additionally, there were teachers who did exchange PLC information with a work group, the school board or other colleagues, through a small conference, for example. For one

PLC, it was reported that they explicitly discussed at the end of every meeting what they would tell colleagues the next day. The external coaches reported that the support from the school is low. One external coach described that it affects teachers' motivation.

6.2.11. Facilitation

6.2.11.1. Questionnaire. Results from the questionnaire showed that teachers on average spent 9.37 ($sd = 4.67$; median, mode = 10) hours on the PLC per month. However, the mean number of hours that were facilitated by their school leader was $m = 8.50$ ($sd = 15.9$, median = 5, mode = 0 and 8). The mean for perception of the PLC as a consistent group of people was 3.75; $sd = 0.87$, which means participants responded on average between 'neutral' and 'agree' to the item 'The PLC consists of the same group of people'.

6.2.11.2. Logs, interviews and observations. The interviews revealed that teachers were facilitated by means of hours, but also spent their own free time on the PLC. Teachers experienced a high work load and there was little time for preparation for the PLC meetings. There were teachers who did not like this, however, other teachers reported being indifferent to this, as illustrated by this participant in an interview: 'I must honestly say that I don't care about the facilitation. I always get an overview of hours for my tasks, I don't care'. One external coach reported that there was a lack of clarity regarding facilitation of PLC participation between the teachers and the school, which led to discussions. Facilities that were provided by the PLC's external coach were materials, a digital environment and the location. These were, in general, positively valued by the participants.

Multiple respondents reported variable group composition (absentees per meeting; new members) for their PLC. This was mostly accompanied by a lack of group cohesion and knowledge of each other, and hindered collaboration according to these participants. This did not match the results of the questionnaire concerning the perception of the PLC as being a consistent group.

6.3. Correlational analysis

Table 5 shows the average scores for the factors, and their correlations with the levels of professional development outcomes. We divided the variables into three distinct categories: input, process and output factors. Most factors and preconditions are positively correlated with all levels of professional development outcomes, except for application of knowledge and skills, specific to the research activities. Support from the school and colleagues were found to be related to different levels of professional development outcomes. Regression analyses were performed using the significantly correlated independent factors.

7. Regression analyses

7.1. Satisfaction

The results of the multiple regression analyses (Table 6) showed that intrinsic motivation, shared goal, leadership (coach) and structured activities all significantly influence satisfaction. For example, an increase of one standard deviation in the score for intrinsic motivation corresponds to an increase of 0.11 in the score for 'satisfaction'. The variables altogether explained 71.2% of the variance in satisfaction.

7.1.1. Knowledge, skills and attitude

The results of the multiple regression analyses (Table 7) showed that intrinsic motivation, extrinsic motivation and collective focus all significantly influence knowledge and skills. For example, an

Table 5
Correlations factors and professional development.

n = 151	Scale	M	SD	Correlations				
				Satisfaction	Knowledge	Attitude	Application (teaching) ^a	Application (research) ^b
	M (SD) ^c			3.64 (0.58)	3.47 (0.64)	3.67 (0.65)	3.45 (0.74)	3.06 (0.97)
Input	Intrinsic motivation	4.13	0.68	0.61**	0.57**	0.47**	0.54**	0.13
	Extrinsic motivation	2.46	0.93	0.16	0.38**	0.36**	0.32**	0.15
	Support (school)	3.51	0.81	0.18*	0.10	0.06	0.03	0.12
	Support (colleagues)	2.86	0.92	0.16	0.25**	0.17*	0.15	0.04
	Prior knowledge ^d	3.18	1.04	0.35**	0.29**	0.07	0.24**	-0.07
Process	Group composition ^d	4.01	0.63	0.17*	0.10	0.15	0.05	-0.15
	Shared goal	3.54	0.71	0.68**	0.54**	0.44**	0.37**	0.04
	Collective focus	3.79	0.70	0.44**	0.48**	0.34**	0.32**	0.02
	Reflective dialogue	3.91	0.62	0.62**	0.41**	0.39**	0.37**	0.07
	Collaboration	3.40	0.60	0.62**	0.52**	0.40**	0.35**	0.09
	Leadership (coach)	4.01	0.65	0.72**	0.53**	0.39**	0.39**	0.08
	Shared leadership	3.54	0.71	0.40**	0.43**	0.38**	0.34**	0.11
	Trust	3.88	0.49	0.62**	0.49**	0.41**	0.39**	-0.01
	Structured activities	3.74	0.63	0.73**	0.54**	0.42**	0.45**	0.10
	Facilitation ^d (hours)	8.50	15.9	-0.10	-0.09	-0.21*	-0.11	-0.03
Output	Satisfaction	3.64	0.58	–	0.62**	0.47**	0.48**	0.09
	Knowledge & skills	3.47	0.64	0.62**	–	0.65**	0.77**	0.29**
	Attitude	3.67	0.65	0.17*	0.65**	–	0.53**	0.23**
	Application (teaching)	3.45	0.74	0.48**	0.77**	0.53**	–	0.38**
	Application (research)	3.06	0.97	0.09	0.29**	0.23**	0.38**	–

Note. 5-point Likert scale 1 = totally disagree – 5 = totally agree.

*p < 0.05. **p < 0.01.

^a n = 134.

^b n = 125.

^c Reported in previous research (Prenger et al., 2016).

^d Based on one item.

Table 6
Results regression analysis for satisfaction (n = 144).

	B	SE B	β
Constant	0.16	0.24	
Motivation (Intrinsic)	0.11	0.05	0.13*
Collective Focus	-0.04	0.05	-0.05
Shared Goal	0.19	0.06	0.23**
Social support (school)	-0.03	0.04	-0.04
Trust	0.10	0.08	0.08
Collaboration	0.08	0.06	0.09
Reflective dialogue	0.06	0.07	0.06
Leadership	0.22	0.07	0.25**
Structured Activities	0.23	0.07	0.25**

*p < 0.05 **p < 0.01.

Table 7
Results regression analysis for knowledge and skills (n = 144).

	B	SE B	β
Constant	-0.17	0.34	
Motivation (Intrinsic)	0.23	0.08	0.24**
Motivation (Extrinsic)	0.15	0.04	0.22**
Collective Focus	0.18	0.07	0.20**
Shared Goal	0.08	0.08	0.09
Social support (colleagues)	0.07	0.04	0.10
Trust	0.10	0.12	0.08
Collaboration	0.09	0.09	0.08
Reflective dialogue	-0.08	0.10	-0.08
Leadership	0.14	0.10	0.14
Structured Activities	0.07	0.10	0.07

**p < 0.01.

increase of one standard deviation in the score for intrinsic motivation corresponds to an increase of 0.23 in the score for 'knowledge and skills'. The variables altogether explained 54% of the variance in knowledge and skills.

Table 8
Results regression analysis for Attitude (n = 144).

	B	SE B	β
Constant	0.62	0.41	
Motivation (Intrinsic)	0.18	0.09	0.19*
Motivation (Extrinsic)	0.17	0.05	0.25**
Collective Focus	0.08	0.08	0.08
Shared Goal	0.10	0.09	0.11
Social support (colleagues)	0.04	0.05	0.06
Trust	0.11	0.14	0.08
Collaboration	0.04	0.11	0.04
Reflective dialogue	0.11	0.12	0.10
Leadership	-0.00	0.12	-0.00
Structured Activities	0.03	0.12	0.03

*p < 0.05, **p < 0.01.

7.1.1.1. Attitude. The results of the multiple regression analyses (Table 8) showed that intrinsic and extrinsic motivation both significantly influence attitude. For example, an increase of one standard deviation in the score for intrinsic motivation corresponds to an increase of 0.18 in the score for 'attitude'. The variables altogether explained 36.2% of the variance in attitude.

7.1.2. Application

7.1.2.1. Application - teaching practice. The results of the multiple regression analyses (Table 9) showed that both intrinsic and external motivation significantly influence application in teaching practice. For example, this means that an increase of one standard deviation in the score for intrinsic motivation corresponds to an increase of 0.40 in the score for 'application-teaching practice'. The variables together explained 36.5% of the variance in application in the teaching practice.

8. Discussion

This study set out to add new dimensions to PLC research. Based

Table 9
Results regression analysis for application in teaching practice (n = 134).

	B	SE B	β
Constant	0.21	0.46	
Motivation (Intrinsic)	0.40	0.11	0.37**
Motivation (Extrinsic)	0.15	0.06	0.19**
Collective Focus	0.08	0.10	0.08
Shared Goal	-0.04	0.11	-0.04
Trust	0.11	0.16	0.07
Collaboration	-0.05	0.13	-0.04
Reflective dialogue	0.03	0.14	0.02
Leadership	-0.01	0.14	-0.01
Structured Activities	0.20	0.14	0.17

* $p < 0.05$, ** $p < 0.01$.

on the known research results on within-school PLCs, it aimed to explore factors influencing networked PLCs. Additionally, factors concerning the geographical, organizational and professional expectation-related boundaries of networked PLCs were investigated, as literature indicated that these could hinder effectiveness of networked PLCs (Chapman, 2014). With a more fundamental understanding of the characteristics that influence different levels of professional development outcomes in networked PLCs, teachers' time and effort regarding PLC participation can be spent more effectively. In this study, we have contributed to this understanding by establishing the relevant factors impacting different levels of professional learning. This study not only shows quantitatively which factors matter and to what extent, but the qualitative data also provide insight into how and why this is the case or what further improvements could be made. Future and existing networked PLCs can make use of this information to promote their effectiveness, and consequently, knowledge dissemination and sustainability.

The findings from the present study support the importance of most of the hypothesized factors for networked PLCs. All factors were significantly correlated to at least one of the levels of professional development outcomes. The role of perceived leadership was particularly evident in the interviews. Although some teacher reported to prefer an unstructured style of leadership, there were teachers who noticed a lack of structure at the start of the PLC, and who wanted to be able to refer to a starting point for their discussions and proceedings. This led to a lack of clarity about the shared goal of the PLC, and not being able to talk to colleagues within their own school about the content of the PLC. This raises questions about the form and extent of the structuring that should be recommended for networked PLCs. Presumably, a balance needs to be found between providing structure to monitor the progress of the PLC, and leaving room for discussion, reflection and exchange of experiences. A study by Binkhorst (2017), for example, showed promising results for working with guidelines for balancing shared and vertical leadership in networked Teacher Design Teams (a type of PLC focused on developing learning material for the classroom).

Overall, for the current early stage of PLC development (one year), motivation, either intrinsic or external, appears to be important for effectiveness at all levels of professional development outcomes. Motivation has been shown to be important in multiple other studies, including in the study by Binkhorst et al. (2015) on teacher design teams. They found in one of their case studies that motivation to participate affected important process factors, such as the perception of a shared goal, and leadership. Additionally, the atmosphere was negatively affected due to skepticism and a negative attitude. The finding that motivation plays a key role for the three levels of professional development outcomes in the present study may have been affected by the PLC's stage of development. Bolam et al. (2005) distinguished three stages of a

PLC – starter (initialization), developer (implementation) and mature (institutionalization). Different factors may influence professional development outcomes during different stages of a PLC. For example, for shared goal, a study by Huffman and Hipp (2003) found that during the initialization phase of the PLC, the emphasis was on espoused values and norms. In the implementation phase, there was a shift to focusing on students and high expectations, and in the institutionalization phase, shared goals or vision guided teaching and learning. The motivation to participate may become less important during later phases of PLC development, as other factors such as shared goal and trust can be assumed to overrate the motivation in later, more familiar phases. Also, it can be assumed that motivation is a professional boundary that is even more important for networked PLCs, as participants come from different school cultures and consequently may have different motivations to participate (e.g., voluntary versus forced participation) (see also Earl, Katz, Elgie, Ben Jaafar, & Foster, 2006). Overall, the significant role of motivation in PLCs implies that to get insight in participants' motivation, this should be discussed in one of the first meetings. Moreover, it could imply that participants may need to be selected based on motivation to stimulate professional learning within the PLC, and hence, within the schools.

Besides the results from the quantitative analyses, qualitative data revealed some noticeable factors that may influence the effectiveness of networked PLCs. First, the facilitation for PLC participation was an important topic among respondents. There were teachers who did not care much about this facilitation and were happy to work on the PLC in their own time, but there were also teachers who reported having quit due to lack of facilitation by the school. This could affect the PLC as a whole, as the composition of the group therefore changed and influences group processes such as collaboration and trust. However, the questionnaire showed that teachers spent more than nine hours on the PLC per month, which is remarkably more than most other PD initiatives, such as data teams (Schildkamp, Poortman, & Handelzalts, 2015) or teacher design teams (Handelzalts, 2009). Before participation, PLC members must make clear and concrete agreements with their within-school supervisors to be able to make optimal use of the networked PLC. In addition, PLC leaders could communicate information on the minimum amount of facilitation that is required to the participating schools.

Second, the research showed that the support received from colleagues is relatively low, meaning that colleagues showed little interest in the teachers' PLC participation and progress. Also, many teachers came individually to the networked PLC. The limited social support may hinder knowledge sharing within the school, and consequently school effectiveness. Katz and Earl (2010) found that the number of within-school colleagues in a networked PLC influenced effectiveness within schools. This suggests that schools should be advised to send more than one delegate per school, the importance of knowledge sharing with school administration and colleagues should be discussed during PLC meetings and teachers should be given hands-on to share knowledge.

9. Limitations

A limitation in this study is that we measured effects based on self-reported perceptions. We accounted for possible bias by applying a mixed-methods methodology in which we triangulated our quantitative and qualitative data. Additionally, we not only examined teachers' perceptions, but also included the perceptions of the external coaches, to take different viewpoints into account. However, the reported (application of) changed knowledge and skills were not validated by means of classroom observations, for example. Second, we included 23 PLCs that all had their own goals

and used their own methods. Therefore, it could be that certain factors are more visible in some PLCs. However, analyses of differences between the three categories of the PLCs regarding effectiveness in terms of teachers' professional development outcomes showed no significant results. Additionally, by using a mixed-methods methodology, we were able to provide insight into the differences between teachers and PLCs.

10. Conclusions

In the present study, the results are presented of a study on the factors influencing the outcomes of 23 networked PLCs in the Netherlands. We can conclude that geographical and organizational boundaries did not have (a significant) impact on professional development in networked PLCs, whereas professional boundaries did have a significant impact in terms of motivation. Motivation is an important factor for professional development in this early stage of the PLCs, and should therefore be addressed during PLC meetings. Beyond motivation, the perception of a shared goal, of leadership by the external coach and of structured activities during

meetings made additional contributions to the prediction of PLC satisfaction. A collective focus on student learning significantly influenced the perception of obtained knowledge and skills. Moreover, all the factors can assumed to be connected to each other. As [Sutherland and Katz \(2005\)](#) indicated, a change in any one invites changes in the rest. Acting on these factors can enable us to guide participants and their colleagues to improve professional development outcomes in networked PLCs.

Acknowledgements

This article is funded and supported by the Dutch Ministry of Education and Culture (grant number 804AO-45775).

Appendix A

Factor solution of independent variables for teachers' professional development in networked PLCs

	Intrinsic motiva tion	Extrinsic motiva tion	Shared goal	Support (school)	Support (collea gues)	Trust	Colla Bora tion	Reflec tive dialo gue	Collec tive focus	Leader ship	Struc tured activi ties	Prior know ledge
I feel participating in the PLC is...												
Interesting	0.704											
Fun	0.694											
Important	0.714											
I would feel guilty if I hadn't participated		0.884										
I would have given me a bad feeling if I hadn't participated		0.942										
To fulfill my job properly, I had to participate in this PLC...		0.540										
Everybody strives for the same goal			0.641									
We agree on what is important			0.537									
We share the same vision and ambitions			0.558									
We are enthusiastic about striving after our collective goals			0.483									
My school (administration)...												
Stands behind my PLC participation				0.607								
Gives me enough time to invest in the PLC				0.708								
Shows to be interested in the PLC's progress				0.774								
Makes me feel supported in my PLC participation				0.829								
My colleagues...												
Stimulate my PLC participation					0.875							
Show interest in the PLC's progress					0.749							
Most people in this PLC...												
Dare to say the truth						0.690						
Help and support each other						0.777						
Stand behind their convictions						0.681						
Are compassionate with others						0.716						
Speak out where they stand for						0.721						
Are open to advice and help of others						0.756						
In this PLC...												
We work together						0.484						
People can trust each other						0.645						
People keep their word						0.559						
Are people sincerely interested in each other						0.633						
We trust completely in each other's capacities when performing a task						0.593						
Are suggestions and contributions of others respected						0.628						
People discuss in a constructive way						0.517						
Are conflicts easily solved						0.446						
People communicate in a personal and direct way						0.583						
In this PLC...												
Every participant gives the PLC the same priority						0.556						
Every participant feels responsible for the results						0.565						
Everybody invests in the PLC						0.755						
All participants feel involved						0.624						
Participants feel proud to be part of the PLC						0.381						

(continued)

	Intrinsic motiva tion	Extrinsic motiva tion	Shared goal	Support (school)	Support (collea gues)	Trust	Colla Bora tion	Reflec tive dialo gue	Collec tive focus	Leader ship	Struc tured activi ties	Prior know ledge
In this PLC...												
We reflect on relevant subjects								0.669				
We discuss the current and desired situation of relevant subjects								0.668				
We draw conclusions out of discussions on relevant subjects								0.430				
In our PLC...												
The ultimate goal is improving student results									0.548			
Are activities focused on improving student results									0.783			
People speak explicitly about improving students results									0.721			
The support of the external coaches...												
Complements the PLC's needs										0.771		
Adds to the PLC's results										0.791		
Adds to the PLC's structure										0.801		
Enables coherence within the group										0.656		
Consists of an active role during meetings										0.809		
Results in useful tips and guides										0.759		
Activities of the PLC are...												
Structured											0.431	
Complementing to the PLC's goal											0.412	
During PLC activities my role is clear to me											0.429	
There is a clear structure between the different activities during meetings											0.388	
About the PLC's subject...												
I had sufficient prior knowledge at the start												0.645
I had the same amount of prior knowledge as others at the start												0.433
I could pass on prior knowledge to others (within the PLC)												0.333

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