Teacher professional learning and collaboration in secondary schools

Jong, L.A.H. de

Chapter 3:
Teachers' Perceptions of Their Schools Changing Towards Professional Learning Communities

Abstract

In professional learning communities (PLCs), teachers collaborate and learn with the aim of improving students' learning. The aim of this study was to gain insight into teachers' perceptions of their schools' change towards PLCs and which conditions support or hamper this change. Questionnaires were completed by a total of 2.111 teachers from 15 Dutch secondary schools for three years. With the use of multilevel regression analyses, the research questions were answered. Although the development of a school towards a PLC seems to be a slow process, the findings demonstrate the influence of school conditions on this development. The condition human resource management (HRM) stands out, as this school condition has a direct and longitudinal effect on the change. The main recommendation is to embed PLC elements in HRM policies such as facilitating teachers to collaboratively work and learn and aligning teachers' professional development with schools' vision and ambitions. PLCs have been studied occasionally in longitudinal in-depth case studies or in large-scale cross-sectional research. This large-scale longitudinal study provides insights into the sustainability of schools as PLCs and the school conditions that are associated with sustainability.

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3.1 Introduction

In the domain of education, the concept of professional learning community (PLC) is commonly used for groups of teachers sharing and critically examining their teaching practices and collaborating on how to support student learning (Stoll et al., 2006). A PLC can be understood as a means to enhance both teachers' professional development and a professional school culture (Achinstein, 2002; Grossman et al., 2001). Positive effects of PLCs in secondary schools are found on students' learning outcomes (Lomos et al., 2011). Related to the organization of schools, PLCs may be operating at different levels (Stoll et al., 2006). A vast amount of the PLC literature refers to groups of teachers within secondary schools, such as departmental PLCs or specific teacher groups (e.g. Campbell & Lee, 2017; de Jong et al., 2019; Slavit & Nelson, 2010; Tam, 2015b; Wong, 2010a).

Schools as PLCs have been studied occasionally in longitudinal in-depth case studies concerning one or two schools (e.g. Hipp et al., 2008; Rismark & Sølvberg, 2011) or in large-scale -mainly cross-sectional- studies (e.g. Antinluoma et al., 2018; Heggen et al., 2018). These longitudinal and large-scale studies reflect different educational levels, including primary and secondary education. Insights in factors that impact the change of secondary schools towards PLCs are lacking, requiring the need for long-term studies. Studying the change provides insights into the sustainability of schools as PLCs. The aim of this study is to gain insight into teachers' perceptions of their schools' (further) change towards PLCs and which factors support or impede this change. Central to this study are teachers' perceptions from 14 Dutch secondary schools. In these schools, a series of interventions to foster schools' development as PLCs were implemented over a period of three years.

3.2 Theoretical Framework

The present study draws on two concepts relevant for studying teachers' professional learning and collaboration in schools, including PLCs and learning organizations.

3.2.1 PLC Reconceptualized

Several scholars that reviewed the literature on *PLCs* point at the fuzziness that comes with defining PLCs. Because a universal definition of PLCs is lacking (Stoll et al., 2006), studies on PLCs differ in their conceptualizations and methodological approaches used (Lomos et al., 2011; Sleegers et al., 2013). For example, different sets of teachers are considered as PLCs, like informal groups of teachers, distinct organizational sub-units, or the entire staff of schools (Warwas & Helm, 2018).

In a recent study, Sleegers et al. (2013) point at three capacities of the entire school staff that define the PLC concept in primary education: personal capacity, interpersonal capacity, and organizational capacity. Personal capacity refers to teachers' reflective professional inquiry and application of knowledge and best practices in their teaching practice. In a PLC, teachers use available knowledge and sources of information to reflect on, assess, and reconstruct their knowledge constantly. Interpersonal capacity entails shared values and vision, collective learning, and shared or deprivatized practices amongst teachers. Organizational capacity is identified by resources (e.g. time, materials, and learning opportunities), relationships, the professional climate of the school, and stimulating and participatory leadership (Sleegers et al., 2013).

Warwas and Helm (2018) set out three core dimensions of PLCs in departments of vocational upper secondary education: behavioral dimension, ideational dimension, and structural dimension. The first dimension is collaborative development which captures the behavioral dimension as members engage in collaborative efforts to improve pedagogical practices. The behavioral dimension includes activities of collaboration, monitoring, and improvement about learning and instruction, such as collegial observation. Normative

agreement refers to the second -ideational- dimension as collaborative efforts need to serve a shared purpose and need to be closely aligned with what constitutes effective teaching. The third dimension entails the supportive infrastructure that depicts the structural dimension of a PLC and refers to routines and resources that promote collaboration (Warwas & Helm, 2018).

The research of Sleegers et al. (2013) and Warwas and Helm (2018) focuses on purposefully organized PLC's which is different from research that focuses on naturally occurring PLC's (e.g. Little, 1990; 2003; Westheimer, 1999). Research on naturally occurring PLC's is concerned with how teachers initiate collaboration themselves with little external interference. Sleegers et al. (2013) and Warwas and Helm (2018) investigate how teacher professional learning and collaboration is purposely facilitated and stimulated in schools, which is reflected in the 'organizational capacity' (Sleegers et al., 2013) or 'structural dimension' (Warwas & Helm, 2018) of PLC's.

3.2.2 PLC in Relation to Learning Organizations

The construct of PLC was proposed by Dufour et al. (1998) as the educational counterpart of the construct learning organization (Senge, 1990), to emphasize the importance of common interest in a group (Vangrieken et al., 2017b). However, according to Stoll and Kools (2017) the term PLC limits its potential for school-wide change and "a more holistic concept is needed to merge the caring, pedagogically focused and collectively responsible aspects of PLC, with further research and theory from other disciplines to capture an organization-wide collaborative culture which places learning at all levels – individual, group and collective – [at the] front and center of school's way of being and operating" (p. 6). Therefore, Stoll and Kools (2017) propose an integrative perspective on the concept of *secondary schools as learning organizations* and set out seven dimensions which schools should focus on: 1) developing and sharing a vision centered on student learning, 2) creating and supporting professional learning opportunities, 3) promoting team learning and collaboration, 4) establishing a culture of inquiry in which development and research processes guide innovations, 5) embedding systems for professional learning such as

data-use to inform school-improvement process and collaborative structures for regular dialogue and knowledge exchange, 6) learning with and from the external environment, and 7) modeling and growing learning leadership. Stoll and Kools (2017) explain that adding the notion of community to learning organizations brings 'heart' into the concept. In other words, it represents the human experience of teachers, students, and school leaders in schools that is not necessarily evident in a learning organization (Mitchell & Sackney, 2006; Stoll and Kools, 2017).

The link between PLCs and learning organizations has been made before by Giles and Hargreaves (2006). These authors stress that in learning organizations, not only innovative structures enable secondary schools to develop their professional capacity, but also the community aspect that draws on shared vision and the collective capacity of staff supports the continuous improvement in schools. In this, connections between personal, interpersonal, and collective learning in school are the keys to change and success (Giles & Hargreaves, 2006; Mulford, 1998). Through teamwork and leadership, and by using data to inquire into and evaluate progress over time, schools build the professional capacity to solve problems and make decisions about teaching and learning. Instead of "quick fixes of superficial change" (p. 126), PLC's in school support sustainable improvements that last over time (Giles & Hargreaves, 2006)

3.2.3 Supportive Conditions for Professional Learning and Collaboration

Various forms of teacher collaboration are currently deliberately initiated in schools to strengthen their culture of professional learning (Admiraal et al., 2019; Hargreaves & O'Connor, 2017). Sustainability and long-term effects of interventions aimed at teacher professional learning and collaboration in schools are however questionable. Successful implementation of interventions, in the sense that teacher professional learning and collaboration actually take place, depends on a range of factors.

At *the individual teacher level*, supportive factors entail, for example, teachers' self-efficacy. When teachers believe that they can cope with work-related difficulties, they will engage more in reflective learning activities (Runhaar et

al., 2010). Another supportive factor is commitment to professional learning. Teachers who are committed feel a strong moral responsibility to improve their teaching quality and keep themselves up to date and thus seek for learning opportunities in school (de Jong et al., 2019; Thoonen et al., 2011). Teacher autonomy is a third teacher-level factor that influences teacher learning and collaboration, although results are not straightforward. In their review, Vangrieken et al. (2015) explain that certain levels of autonomy support teachers' engagement in collaboration, but that high feelings of autonomy might lead to disengagement and isolation in school. Vangrieken et al. (2017a) provide a conceptualization of autonomy in relation to collaboration. Autonomy that is combined with a strong desire for individual and independent work is defined as reactive autonomy. Autonomy that is paired with an openness toward collaboration is defined as reflective autonomy. Reflective autonomy does not mean excluding consulting others. Rather, reflective autonomy is seen as making peronal choices through an interpersonal process (Vangrieken et al., 2017a, quoting; Koestner & Losier, 1996).

At *the group level*, factors can be identified as well. For example, teacher collaboration is supported when teachers have a clear role in a group (Vangrieken et al., 2015) or when the group has a clear focus or common goal (Hadar & Brody, 2010; Kintz et al., 2015; Vangrieken et al., 2015).

At *the level of the school*, a common factor is leadership, relating to school leaders who inspire and support their staff, facilitate learning opportunities, and have a clear vision for the future (e.g. Admiraal et al., 2016; de Neve & Devos, 2017; Ioannidou-Koutselini & Patsalidou, 2015). In some studies, this type of leadership is also referred to as transformational leadership (Runhaar et al., 2010; Thoonen et al., 2011). Other school-level factors relate to a culture of openness, understanding, teamwork, and trust (de Jong et al., 2019; de Neve & Devos, 2017; Ioannidou-Koutselini & Patsalidou, 2015, Vangrieken et al., 2015), a shared school mission and vision amongst the staff members (Admiraal et al., 2016; Opfer et al., 2011a), time and space to meet (Admiraal et al., 2016; de Neve & Devos, 2017; Opfer et al., 2011a; Vangrieken et al., 2015), and embeddedness of teacher professional learning and collaboration in school

practices and human resource management (Admiraal et al., 2019). With human resource management (HRM) we refer to school policy that facilitates and encourages teachers to professionalize and collaborate. For example, addressing co-design and inquiry-based working during performance appraisals, and letting teachers keep a portfolio to monitor their professional development.

3.2.4 Purpose of the Study

A range of studies has identified factors that support teachers' professional learning and collaboration in school. These factors relate to features at the level of individual teachers, teacher groups or teams, and schools. In the present study, we focus on school factors which we indicate as *PLC conditions*. PLC conditions reflect contextual indicators that are expected to enhance professional learning and collaboration in school. We use the term *PLC elements* to denote indicators of teachers' professional learning and collaboration, such as teachers' reflective professional inquiry, collective learning, and shared or deprivatized practices in school.

Similarly to Sleegers et al. (2013) and Warwas and Helm (2018), we focus on schools that purposely facilitated and stimulated teacher professional learning and collaboration. The context of the current study is a Dutch government initiative to support schools during a three-year period to stimulate collaborative practices and learning of their teachers. In (secondary) education, one major challenge in supporting collaboration relates to teachers' primary task of teaching. In general, teaching reflects autonomous and isolated work because it takes place behind closed doors (Hodkinson & Hodkinson, 2003). In secondary education, the division of teachers over departments can create even more distance between teachers (Hargreaves & Macmillan, 1995). Opportunities for teacher learning and collaboration in secondary schools concern teachers' shared target group, as students are taught school subject by different teachers. Central to this study are teachers' perceptions of their secondary school's PLC elements and PLC conditions during three years. By studying the change, we aim to gain insight in the sustainability of schools as PLCs. The following research questions are formulated:

- How do teachers' perceived PLC elements and PLC conditions in school change over time?
- In what way do teachers' perceived PLC conditions predict teachers' perceived PLC elements in school?
- In what way do teachers' perceived PLC conditions (and the change therein) explain changes in teachers' perceived PLC elements in school over time?

3.3 Methods

3.3.1 Sample

Across the three school years, a questionnaire was completed by 2.111 teachers from 15 schools, which represents a teachers' response rate of 60%. School sizes ranged from 700 to 2.635 students and 67 to 210 teachers per school. After year 2, one school opted out from the research due to closing. Demographic information about the sample is presented in Table 3.1. The sample included 48% female teachers, which is similar to the gender distribution in Dutch secondary education (Dutch Ministry of Education, Culture, and Science, 2019). Teachers working 10 years or more in education represented the largest proportion of teachers (55%), followed by teachers working 5-10 years in education (19%).

3.3.2 Procedure

The 15 secondary schools under study participated as a result of a call of the Dutch government to support schools in their development as PLC. To this end, each school planned and implemented a series of interventions, tailor-made on their needs, during three school years (September 2014 to June 2017). The interventions related to school vision, professional learning of staff, collaboration, school organization, and leadership. Examples of interventions are the implementation of collegial observation and a school academy as formal structure to bring together all professional development activities (Admiraal et al., 2019). The schools were supported by an external project leader in planning, designing, and implementing interventions. The researchers were invited to

monitor the changes in the schools because of their expertise in research on teacher collaboration and professional development in secondary schools. The researchers were unaffiliated with the project leader and carried out the research independently from the work of the project leader.

Table 3.1
Teachers' Mean Age (Standard Deviation) and Percentage of Teachers for Demographics per First Year the Teacher Filled In the Questionnaire

Demographic	Year 1 (N=1251)	Year 2 (N=474)	Year 3 (N=386)	Total (N=2111)
		Age (M (SD))		
	42.81 (12.44)	41.98 (12.56)	41.40 (12.65)	42.06 (12.55)
		Gender		
Female	47	50	49	48
Male	53	50	51	52
		Years of Working in Education		
< 1 year	5	7	12	7
1-2 years	5	8	8	6
2-5 years	12	13	12	13
5-10 years	20	19	18	19
≥ 10 years	58	53	50	55
		Years of Working at Current School		
< 1 year	11	20	26	16
1-2 years	7	9	12	8
2-5 years	16	16	14	16
5-10 years	25	17	15	21
≥ 10 years	41	37	34	39
		Additional Task		
Management	<1	<1	<1	<1
Middle management	4	3	2	3
Quality/policy officer	2	1	1	1
Other	11	8	3	9

3.3.3 Instrument

We used the questionnaire School as PLC (Schenke et al., 2015) to assess teachers' perceptions of professional learning and collaboration in their school. The questionnaire was designed drawing from the literature on elements and conditions of a PLC. The elements refer to indicators of schools as PLC's, such as sharing knowledge and collaboration (e.g. Hipp et al., 2008; Stoll et al., 2006). The conditions refer to matters that support the development and sustainability of schools as PLC's, such as leadership and communication in school (e.g. Opfer et al., 2011a; Runhaar et al., 2010). We carefully translated and adapted the items drawn from the English literature to meet the Dutch secondary educational context. To fine-tune the questionnaire, educational scientists that were not involved in the study were invited to a session to review item formulations (in Fall 2014). The outcome of this session was to keep the original scales, but adapt some item formulations to match the educational practice better. The questionnaire has been validated and has good psychometric properties (Schenke et al., 2015).

The original questionnaire consists of 66 items, each scored on a 5-point Likert scale ranging from 1 (entirely not applicable) to 5 (entirely applicable). The option to select a sixth category 'I don't know' was also available. This option was coded as a missing value for the item in question. For each item, teachers indicated the extent to which it applied to their school at that particular moment in time. Items refer to five elements of a school as PLC (e.g. Co-design and Inquiry-based working) and seven conditions for the development and sustainability of a school as PLC (e.g. Professional autonomy and Leadership). A description and sample items of the PLC elements and conditions are provided in Table 3.2.

We conducted a Confirmatory Factor Analysis using the statistical software R (version 3.6.0) and R Studio (version 1.1.456; R Core Team, 2019) to examine the factorial measurement structure of the questionnaire for the elements (5 factors) and the conditions (7 factors) separately. For all three years (i.e. year 1, 2 and 3), the five-factor measurement model for the elements and the seven-factor measurement model for the conditions demonstrate a good to very good

Table 3.2

Description and Sample Items of Elements and Conditions of a School as PLC

PLC Elements and PLC Conditions	Description	Sample item
	PLC Elements	
Professional development outside school	Professional development that takes place outside school, such as workshops and Master's programs.	In our school, external training and courses for teachers are offered.
School-based professional development	Professional development that takes place inside school, such as teacher design teams or collegial observation.	In our school, it is common practice that teachers observe and discuss each other's lessons.
Knowledge sharing	Teachers' knowledge sharing on teaching experiences, the quality of education and their educational vision.	In our school, teachers share knowledge and experiences that are important to the quality of education.
Co-design	Teachers' collaborative design of new methods and year programs or to solve problems.	In our school, teachers collaboratively develop new teaching methods.
Inquiry-based working	Teachers' use of inquiry-based methods to improve teaching, such as data-use, feedback, or theory.	In our school, teachers use available data (like test results of students) systematically to develop their teaching practice further.
	PLC Conditions	
Shared support	Shared vision on key issues of education and shared commitment, to pursuit the school vision.	In our school, teachers are willing to contribute to changes/innovations in school.
Professional autonomy	Possibilities for teachers to develop and decide on teaching, and the extent to which teachers take responsibility in the educational quality.	In our school, teachers have a say in themes the school wants to develop further.
Leadership-principal	Facilitation, support, and encouragement from the board to (further) develop the school towards a PLC.	The board involves teachers actively in developing a vision for education.
Leadership-middle management	Facilitation, support, and encouragement from the middle management to (further) develop the school towards a PLC.	The middle management (team or department leader) involves teachers actively in developing a vision for education.

HRM	School policy that facilitates and encourages teachers to professionalize and collaborate by, for example, addressing co-design and inquiry-based working during performance appraisals, and let teachers keep a portfolio to monitor their professional development.	In our school, teachers are facilitated in time and space to collaborate in the development of teaching practices.
Communication in school	Oral and digital communication on developments in school such as the schools' ambition and communication between teachers and school leaders.	In our school, themes on which the school wants to develop further, are discussed during meetings.
Collegial support	The expression of mutual respect and being open showing vulnerability.	In our school, we are open to each other.

Note. The questionnaire consists of 66 items, with six items per PLC element and condition, except Professional development outside school and School-based professional development which include three items each.

fit to the data as demonstrated by the Comparative Fit Index > .90, the Tucker-Lewis Index > .90, the Root Mean Square Error of Approximation < .08, and the Standardized Root Mean Square Residual < .08. Regarding the elements, we allowed the residuals of three pairs of items from the subscales School-based professional development and Co-design to correlate as these items were related to designing educational materials. Furthermore, the internal consistency of all scales for all years is good as Cronbach's $\alpha > .80$, except for the scales Professional development outside school and School-based professional development with α ranging from .64 to .74 which is probably due to the small amount (i.e. three) of items of these two scales.

3.3.4 Data Imputation

The largest proportion of missing data was found in the data of year 1 on the scale Professional autonomy (59%) due to an online technical error. The proportion of missing data on the remaining scales of years 1, 2, and 3 ranged from 1% to 15%. The sample size per PLC element and PLC condition for years 1, 2, and 3 can be found in Table 3.3. Little's Missing Completely at Random

test indicated that the missing data from year 2 were missing *completely at random* (χ^2 (444) = 485.10, p = .09). This indicates that the participants with completely observed data are a random sample of all the participants from the population and not a subgroup that behaves differently than the participants with missing data (Little & Rubin, 2019). The missing data from years 1 and 3 were not missing completely at random (for year 1: χ^2 (850) = 1133.19, p = .00; for year 3: χ^2 (533) = 725.06, p = .00). Although it is not possible to test whether missing data are missing *at random* or missing *not at random*, inspection of the data and t-tests suggested that the missing data from years 1 and 3 were missing at random. Namely, although the probability to be missing is not the same for all cases (i.e. teachers), the probability of missing seems to depend on observed information (Grund et al., 2016a; Rubin, 1976).

Table 3.3
Sample Size (Amount of Teachers) per PLC Element and Condition per Year of Data Collection

PLC Element and Condition	Year 1	Year 2	Year 3
Total Sample			
	1.251	961	928
Response rate (*M*, [*min-max*])			
	69%, [43%-91%]	56%, [35%-100%]	56%, [39%-94%]
Elements			
Professional development outside school	1192	948	905
School-based professional development	1185	930	897
Knowledge sharing	1221	949	897
Co-design	1187	932	862
Inquiry-based working	1133	902	812
Conditions			
Shared support	1174	922	825
Professional autonomy	519	903	818
Leadership-principal	1134	901	819
Leadership-middle management	1067	894	805
HRM	1105	886	819
Communication in school	1149	900	823
Collegial support	1155	900	905

To deal with missing data, we performed multiple imputation. The results from the cross-sectional analyses were obtained after performing multiple imputation for the year 1 data. The results from the longitudinal analyses were obtained after performing multiple imputation for the data from years 1, 2, and 3. Auxiliary variables were included in the imputation model to enhance the possibility of missing at random (Collins et al., 2001; Grund et al., 2016a), including teachers' age, gender, level of education, and the department in which they (mostly) work. Because of the hierarchical structure, as teachers are nested in schools and -in the longitudinal analysis- measurements are nested in teachers, we used the R pan package (Schafer & Zhao, 2014) in conjunction with the mitml package (Grund et al., 2016b) to carry out multiple imputation while taking the multilevel structure into account. Based on recommendations by Grund et al. (2016a), we ran pan for 50000 burn-in iterations, after which 100 imputed data sets were drawn, each spread 5000 iterations (cross-sectional analyses) and 10000 iterations (longitudinal analyses) apart for fitting a random-intercepts model. Based on the potential scale reduction factor and the diagnostics plots, we concluded that the pan algorithm has converged and that the imputed data sets are approximately independent draws from the posterior predictive distribution (Gelman & Rubin, 1992; Grund et al., 2016a).

3.3.5 Data Analysis

To answer the first research question, we tested for a significant mean difference between each pair of years in PLC elements and PLC conditions by means of a multilevel t-test.

To answer the second and third research question, two sets of multilevel analyses were used (i.e. multilevel cross-sectional and multilevel longitudinal regression analysis) by adopting the lmer function from the lme4 package in R (Bates et al., 2015). To evaluate whether data within schools are correlated, we estimated the empty model without any predictor, also called the unconditional means model. Based on this model, for each PLC element in years 1, 2, and 3 separately, we computed the intraclass correlation.

To answer the second research question, we conducted, for each year apart, multilevel *cross-sectional* regression analyses for the five outcome measures (i.e. PLC elements) separately, with the PLC conditions used as predictors. We used two-level multilevel techniques with random intercepts (but not random slopes) because the data have a hierarchical structure as teachers (level 1) are nested in schools (level 2), allowing to account for the data from teachers from the same school being correlated (Hox, 2010).

To answer the third research question, we conducted *longitudinal* multilevel analyses to get more insight in the predictive value of the (time-varying) PLC conditions. Again, we conducted separate three-level multilevel regression analyses for the five outcome measures (i.e. PLC elements), including random intercepts (but not random slopes) for teachers and schools. A three-level model was specified with level 1 representing the repeated measurements over time. Level 2 modeled teacher-level variance in PLC elements, whereas level 3 modeled school-level variance in PLC elements. Due to the multiple imputation, no single estimate of model fit was available (Grund et al., 2016a).

To evaluate whether the required assumptions for the multilevel regression analysis were met, we checked the assumptions of homoscedasticity, normality, linearity and multicollinearity and checked for outliers in the data. No (substantial) violations of these assumptions were encountered.

3.4 Results

3.4.1 Change of PLC Elements and Conditions

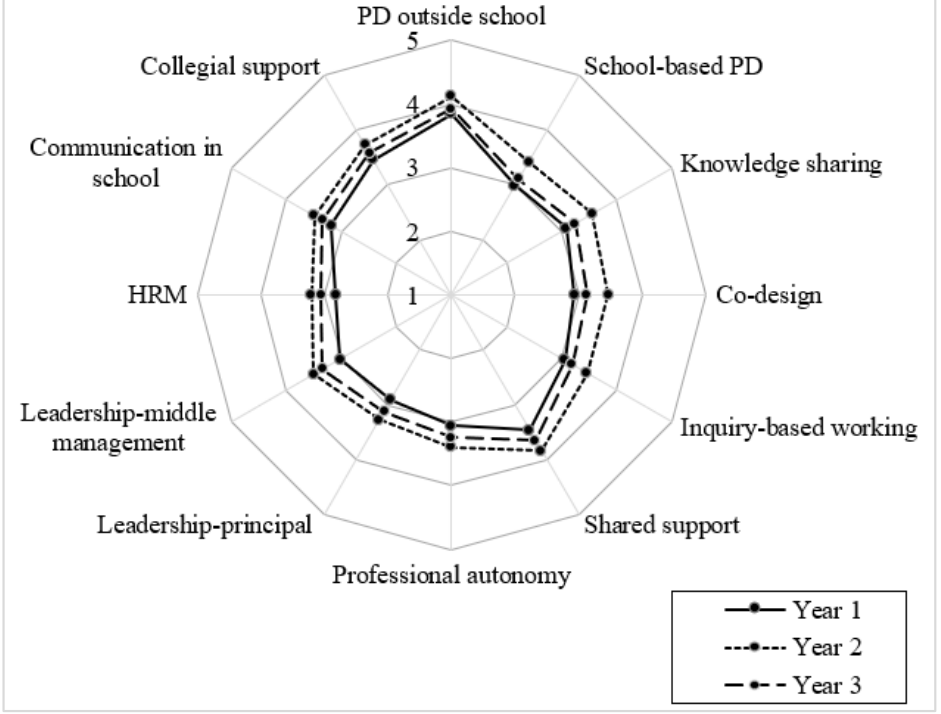
The PLC elements and PLC conditions were tested for a significant mean difference between (pairs of) years with a multilevel t-test. Overall, as can be seen in Figure 3.1, the average scores on the PLC elements and PLC conditions significantly increase after the first year and significantly decrease after the second year. Nevertheless, the average scores in year 3 are significantly higher than the average scores in year 1. All PLC elements and conditions are moderately positively correlated across all years.

3.4.2 The Prediction of PLC Elements by PLC Conditions

The results of the cross-sectional analyses are depicted in Table 3.4. The intraclass correlations were significantly different from zero which means that overall, the perceptions of the PLC elements of two teachers from the same school are more similar to each other than the perceptions of two teachers from different schools. The intraclass correlations varied from .01 to .23, indicating that 1% to 23% of the total variance in perceived PLC elements is situated at the school level (i.e. between school differences), whereas 77% to 99% is attributed to individual differences between teachers (i.e. within school differences).

Out of the seven PLC conditions, Shared support and HRM are -for (almost) each year- significantly contributing to the prediction of all PLC elements, indicating that more Shared support and HRM is related to more Professional

Figure 3.1
Mean Scores of PLC Elements (Professional Development Outside School, School-based Professional Development, Knowledge Sharing, Co-design, and Inquiry-based Working) and PLC Conditions (All Others) in Years 1, 2, and 3



development outside school, School-based professional development, Knowledge sharing, Inquiry-based working, and Co-design. Communication in school significantly predicts all PLC elements except School-based professional development. As for leadership in school, more Leadership of the principal predicts more School-based professional development and Co-design, whereas more Leadership of the middle management predicts more Knowledge sharing. With respect to the two remaining PLC conditions, Professional autonomy and Collegial support, no consistent predictive relations with PLC elements exist.

3.4.3 Explaining Change in PLC Elements Over Time by PLC Conditions

As can be seen in Table 3.5 (row 'Time'), the time (main) effect for the five PLC elements was not statistically significant, indicating that Professional development outside school, School-based professional development, Knowledge sharing, Inquiry-based working, and Co-design did not significantly change over time.

The significant (main) effects for the PLC elements found in the longitudinal analyses (the seven rows below the 'Time' row in Table 3.5) relate to the effects for the scores in year 1 and thus are very similar to the effects found in the cross-sectional analyses for year 1 (see Table 3.4). Regression coefficients, although, differ slightly in size because teachers who did not complete the questionnaire in year 1 (but completed the questionnaire in year 2 and/or year 3), were excluded from the cross-sectional analyses for year 1 but were included in the longitudinal analyses.

We found one PLC condition, HRM, predicting the change of PLC elements across three years (i.e. interaction between a PLC condition and time). In particular, HRM predicts the change (i.e. slope) in Co-design ($b = 0.06$; $p \leq .05$). A visual representation of this interaction effect can be found in Figure 3.2 in which the (estimated) change in Co-design over time is displayed for various levels of HRM. As can be seen, specifically those teachers who initially reported (relatively) high levels of HRM, increased in their perception of Co-design (indicated by the upper line) over time. Teachers who initially reported (relatively) little or average HRM, had no growth or even showed a decline in their perception of Co-design (indicated by lower and middle line) over time.

Table 3.4

Model Estimates of the Two-level Cross-sectional Regression Analysis of Teachers' Perceptions of PLC Elements Year 1, Year 2, and Year 3 (Only Showing Effects Significant at)

Parameter	PLC Element														
	Professional development Outside School			School-based professional development			Knowledge Sharing			Inquiry-based Working			Co-design		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Fixed Effects (PLC condition)															
Intercept	2.19***	2.17***	2.43***	0.67***	0.63**	0.42*	0.53***	0.88***	0.36**	0.59***	0.67***	0.34**	0.44***	0.73***	0.20
Shared support		0.13**	0.16**	0.28***	0.26***	0.23***	0.34***	0.33***	0.38***	0.46***	0.49***	0.57***	0.31***	0.45***	0.40***
Professional autonomy															
Leadership-principal		0.18***		0.26***	0.17**	0.20**							0.16**	0.12**	
Leadership-middle management			0.10*				0.16***	0.09*	0.11**	0.08*					
HRM	0.12**		0.12*	0.20***	0.17***	0.31***		0.13**	0.11**	0.12***	0.14***	0.14***	0.08*	0.08*	0.18***
Communication in school	0.14**	0.20***	0.12*				0.24***	0.11*	0.16**	0.13***	0.09*	0.11*	0.17***		0.19***
Collegial support				-0.09*	0.09*			0.07*						-0.08*	
Random Effects															
Level 1 - teachers (σ^2_{e0})	.64	.33	.48	.55	.40	.50	.42	.27	.35	.35	.22	.25	.41	.30	.35
Level 2 - school ($\sigma^2_{\mu 0}$)	.04	.03	.05	.11	.07	.08	.00	.01	.01	.00	.01	.01	.00	.02	.02
Unconditional Means Model															
ICC	.12***	.14***	.13***	.21***	.19***	.11***	.07***	.04***	.03***	.06***	.06***	.06***	.08***	.10***	.07***

Note. Per cell: regression coefficient; ICC = intraclass correlation coefficient.
*p ≤ .05. **p ≤ .01. ***p ≤ .001.

Table 3.5

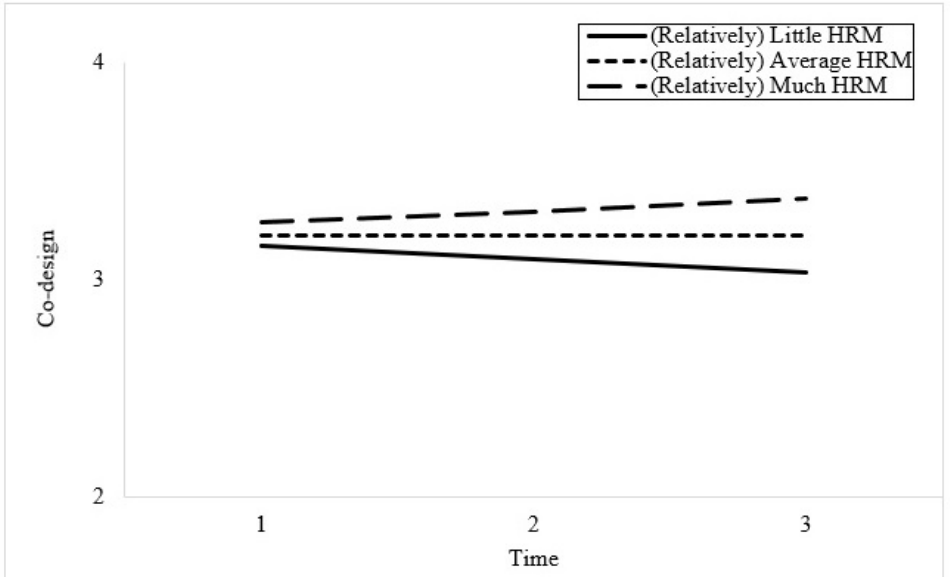
Model Estimates of the Longitudinal Multilevel Analysis of Teachers' Perceptions of PLC Elements (Only Showing Effects Significant at $\alpha = 0.5$)

Parameter	Δ PLC Element				
	Professional development outside School	School-based professional development	Knowledge Sharing	Inquiry-based Working	Co-design
Fixed Effects (PLC Condition)					
Intercept	2.32***	0.53**	0.46***	0.64***	0.33*
Time					
Shared support	0.13*	0.26***	0.36***	0.49***	0.38***
Professional autonomy					
Leadership-principal		0.23***		0.11*	0.15**
Leadership-middle management			0.15***		0.10*
HRM	0.13**	0.16***	0.08**	0.10***	
Communication in school	0.14**		0.19***		0.11*
Collegial support					
Time*Shared support					
Time*Professional autonomy					
Time*Leadership-principal					
Time*Leadership-middle management					
Time*HRM					0.06*
Time*Communication in school					
Time*Collegial support					
Random Effects					
Level 1 - teachers (σ^2_{e0})	0.14	0.13	0.02	0.10	0.13
Level 2 - school ($\sigma^2_{\mu 0}$)	0.03	0.06	0.01	0.01	0.01

*p ≤ .05. **p ≤ .01. ***p ≤ .001.

Figure 3.2

Visual Representation of the Significant Interaction Effect Between HRM and Time on Co-Design. The Evolution of Co-Design over Time is Displayed as a Function of HRM. The Three Lines Represent Little (M - 1 SD), Average (M), and Much (M + 1 SD) HRM



3.5 Discussion

The aim of this study was to gain insight into the change of teachers' perceptions of the learning culture of their school over time and what conditions support or hinder this change. The concept of schools as PLCs has been used for this. We focused on five PLC elements (i.e. Professional development outside school, School-based professional development, Knowledge sharing, Co-design, and Inquiry-based working) and seven PLC conditions (i.e. Shared support, Professional autonomy, Leadership-principal, Leadership-middle management, HRM, Communication in school, and Collegial support). The findings of this study are vital to policy makers, school leaders, and other facilitators of schools as PLCs, because previous longitudinal research studying *how* school cultures of professional learning and collaboration change over time is scarce.

Overall, the results of our questionnaire study show that teachers' perceptions of all PLC elements and PLC conditions significantly increased after year 1 but decreased after year 2. Yet, over the three-year period, teachers' perceptions of the PLC elements and PLC conditions significantly increased. The results are in line with previous studies which conclude that the development of a school towards a PLC is a slow process in which schools take steps forward and steps back (Admiraal et al., 2019; Hargreaves & O'Connor, 2017; Hipp et al., 2008). Hipp et al. (2008), who studied two primary and secondary schools during five years, summarize the development as "a journey as evidenced by the time and energy exerted to move schools from one level to the next, from initiation to implementation to institutionalization or sustainability" (p. 192). Our findings imply that the schools succeeded in implementing initiatives aimed at teacher collaboration and learning to some extent, because teachers' perceptions of PLC elements became more positive over time. In terms of institutionalization, it remains less clear to what extent the change initiatives sustained because the increase in PLC elements during three years was relatively small.

The results of this study point at the influencing potential that school conditions bring as it comes to the development of schools as professional learning community. Several PLC conditions significantly contributed to the prediction of PLC elements. In this, especially the conditions Shared support, HRM, and Communication stood out. These findings illustrate that besides innovate structures, the 'human experience' or interpersonal caring in terms of taking shared responsibility as reflected in Shared support, and appreciation as reflected in HRM, are important affordances for schools as PLC's (Giles & Hargreaves, 2006; Mitchell & Sackney, 2006; Stoll & Kools, 2017). Striking is that Communication is a significant predictor of all PLC elements except School-based professional development, which can be explained by the nature of the PLC elements. Namely, School-based professional development reflects more intensive forms of teacher collaboration, such as collegial observations, than other PLC elements (e.g. Knowledge sharing) and it might require intensive PLC conditions such as Shared support or HRM, which makes communication less relevant in this regard. Formal forms of leadership also significantly contributed

to the prediction of various PLC elements. These findings indicate that school leaders may directly affect teachers' collaborative work and learning by showing enthusiasm for new ideas and projects and offering teachers time and space to put it into practice (Admiraal et al., 2016; Hargreaves, 2019; Schipper et al., 2019). Yet, the literature also points at the risk of hierarchical relationships between school (middle) management and teachers which can contribute to teachers' mistrust of (top down imposed) projects, making collaboration problematic (Brodie, 2019; Hargreaves & O'Connor, 2017; Hipp et al., 2008). This might explain our finding that leadership is a less stable predictor (i.e. a significant predictor of less PLC elements and in less years) than the PLC elements Shared support, HRM, and Communication.

Surprisingly, we found no or only little evidence for the prediction of PLC elements by the PLC conditions Professional autonomy and Collegial support. Closely linked to the ongoing debate regarding the impact of formal leadership in school, research evidence on teachers' sense of autonomy and collegial relationships is not univocal. Top down imposed improvement can restrain feelings of autonomy (Brodie, 2019) and undermine rather than enhance levels of collegial trust (Hargreaves & O'Connor, 2017). Moreover, Vangrieken et al. (2015) warn that high feelings of autonomy might lead to disengagement and isolation in school and thus limit teachers' engagement in (professional) collaboration. Yet, autonomy in itself does not exclude a desire to collaborate and the combination of teacher autonomy paired with a collaborative attitude indicates a more interpersonal definition of autonomy (Vangrieken et al., 2017a). Possibly, teachers' status or experience plays a role in this. Beginning teachers might feel less comfortable with much freedom in making decisions and need more guiding frameworks than experienced teachers. In PLCs, the coordination of collaboration can play out differently for members, depending on their needs. Furthermore, de Jong et al. (2019) illustrate how communities that reflect close collegial relationships may challenge and even hinder development over time by adhering to the state of affairs. Thus, our findings also show how the human experience of autonomy is a distinctive but challenging feature of schools as PLCs.

The longitudinal analyses of this study pointed at the importance of HRM in school. We can conclude that this school condition has a significant direct effect on the change of schools towards PLCs over three years. Indeed, HRM seems to hold the potential of enhancing teacher professional collaboration and learning in school (Runhaar, 2017). This requires not only organizational structures that provide teachers with the necessary time and facilities to collaborate, inquire, and learn (Admiraal et al., 2016; 2019). Our study also stresses the importance of valuing PLC elements, by addressing them in performance appraisals and teacher portfolios, and by expressing appreciation for the work of teachers. Thus, embedding elements of a PLC in the school organization adds to moving schools towards a culture of professional learning and collaboration. Based on our outcomes, however, this change seems to especially concern those teachers who initially reported (relatively) high levels of HRM. Our findings indicate that for teachers who have initially a more moderate perception of their school's HRM, school improvement in terms of (further) developing towards a PLC has no or little impact on them. This is in line with conclusions from Hargreaves and O'Connor (2017), who state that the success of short-term collaborative interventions depends on the prior existence of a collaborative culture in the school. Our study implicates that embedding collaborative and professionalization initiatives in HRM early on in the process, supports the sustainability of such initiatives.

3.6 Limitations and Recommendations for Future Research

Certain limitations must be taken into account when interpreting the results of this study. First, the data concerned self-perceptions of teachers which might reflect teacher satisfaction and entail the risk of social bias. This implies that we can only speak of teachers' perceptions of elements and conditions of the school as PLC.

Second, our sample consisted of teachers working in schools that were involved in a Dutch government initiative, which limits the generalizability

of the results. Furthermore, the generalizability across national borders is limited because countries differ in the accessibility of individual and collective professional development (OECD, 2019a) and the division of responsibilities between management levels (Stoll & Kools, 2017). In the Netherlands, schools are highly decentralized and autonomous on matters related to resource allocation (OECD, 2014). In terms of collaboration and TPL, teachers in the Netherlands are, on average, less likely to engage in team teaching and observe teachers and provide feedback than their international peers (OECD, 2020).

Third, the aim of our study was to identify (teachers' perceptions of) school conditions that have a direct effect on schools' change towards PLCs. Although our results demand further research on the inconclusive impact of leadership, teacher autonomy, and collegial trust, this was beyond the scope of our research.

The fourth limitation relates to the risk of common method variance. This means that the estimated effects of PLC elements on PLC conditions might be biased because they are measured with the same instrument. Future research into the development of schools as professional learning communities would benefit from data triangulation (e.g. by conducting in-depth interviews or observing teacher meetings), considering including a broader range of schools, insight into different forms of leadership, and an exploration of teacher reflective autonomy (i.e. autonomy paired with a collaborative attitude; Vangrieken et al., 2017a; Koestner & Losier, 1996).

Future research would also benefit from insight into how specific interventions are implemented and experienced by teachers (e.g. by in-depth qualitative research), which is needed to inform school leaders and other facilitators on how to support a culture of collaborative learning and working.

Another interesting area for future research on schools as PLCs relates to the within-school variance in PLC elements and PLC conditions. Because of the departmental organization of schools, teachers often work in subgroups which can create the existence of subcultures in schools (Hargreaves & Macmillan, 1995) which is worth noting in future research.

One of the underlying reasons for schools to purposefully facilitate and stimulate a culture of professional learning and collaboration is to enhance teachers' professional development. Yet, collaboration and professional development in itself does not lead to learning. It would be worthwhile to address the micro-processes, in terms of teacher dialogue, taking place in schools as PLCs in future research. Namely, recent research shows how the engagement in critical conversations with colleagues on student learning stimulates teachers' learning (e.g. Warwick et al., 2016).

By providing insight into the change of schools as PLCs over time and identifying relevant school conditions that are associated with this change, the results of this study provide future directions for research, policy and practice. Our study points to the vital role of HRM in school organizations. Therefore, our main recommendation is to embed PLC elements in HRM policies such as facilitating teachers to collaboratively work and learn and aligning teachers' professional development with schools' vision and ambitions. In conclusion, the development of schools towards PLCs is a slow process which requires, for it to be sustainable, continuous support from teachers and school leaders and a permanent and well considered place in school policy.