

The Effects of Networked Professional Learning Communities

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Abstract

Teacher professional learning is considered crucial for improving the quality of education. Teacher collaboration in professional learning communities can contribute to the effectiveness of professional development efforts. In the past decade, there has been a shift from within-school to between-school professional learning communities. However, results regarding their effectiveness have been inconsistent. In this study, we examine the effects of 23 networked professional learning communities in the Dutch context, using a mixed-methods approach. Results showed moderately positive effects on teachers' perceived satisfaction; the knowledge, skills, and attitude developed; and their application to practice. Considering the early stage of development of these professional learning communities, teachers' participation in networked professional learning communities seems promising for enhancing their professional learning.

Keywords

professional development, professional learning communities, mixed methods, teacher learning

The fast-changing society and knowledge leads to the international focus on school improvement to better prepare students for the higher educational demands of the 21st century (Schleicher, 2012). This means that educators and school leaders need to learn faster than ever (Kools & Stoll, 2016). Teachers are urged to become “high-level knowledge workers” (Schleicher, 2012, p. 11). They are expected to constantly advance both their own professional knowledge and that of their profession. High-quality and continuing professional learning is therefore necessary to ensure that all teachers are able to meet these demands (Kools & Stoll, 2016; Schleicher, 2012). Teachers can be supported in rethinking their own practice and improving their teaching by working and learning together (Vescio, Ross, & Adams, 2008). Teacher collaboration in professional learning communities (PLCs) can lead to the level of increased student learning (Borko, 2004; Darling-Hammond, 2010; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Vescio et al., 2008). Therefore, teacher participation in PLCs is a promising strategy for promoting professional learning. PLCs often consist of teachers working together, and sometimes also school leaders (Lomos, Hofman, & Bosker, 2011; Stoll et al., 2006). Professional teamwork and networks of teachers can contribute substantially to continuous school improvement (Sahlberg, 2011). Moreover, “the increased complexity of a fast changing world has brought new challenges for schooling that are too great for those in any one school to address alone” (Stoll, 2010, p. 4). In other words, sustaining schools in the 21st century is promoted through their connection to diverse partners and networks. This means that a more recent

focus for sustaining change in educational systems is the shift in emphasis from *within*-school to *between*-school (and *beyond*-school) improvement (Chapman, 2014).

Theoretical Framework

There is no universal definition in the literature about what a PLC is (Stoll et al., 2006). Overall, it refers to “a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way; operating as a collective enterprise” (Stoll et al., 2006, p. 223). PLCs have basic common characteristics such as shared goals and reflective dialogues (Stoll et al., 2006; Vescio et al., 2008). The concept is rooted in the knowledge and experience that has been gained over many years from encouraging teachers to work together more collaboratively (Harris & Jones, 2010; Lieberman & Pointer Mace, 2010). Overall, different researchers in multiple studies have been using five interconnected variables to define the concept of a PLC (Lomos et al., 2011). First, reflective dialogue is about the extent to which teachers engage in professional dialogues about relevant educational

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subjects. Second, deprivatization of practice refers to the activity that teachers observe each other's classes with the aim of giving and receiving feedback for improvement. Third, collaborative activity refers to the extent to which teachers professionally engage with others within the PLC context. Fourth, shared goals means the extent to which teachers agree with the PLC or school's mission and its principles. Finally, the collective focus on student learning refers to the mutual commitment of teachers for improved student achievement (Lomos et al., 2011). As the concept of a PLC is rather complex, multiple researchers have added additional characteristics to define the concept, such as leadership (e.g., Huffman & Jacobson, 2003; Katz & Earl, 2010), structured and guided activities with a relation to practice (e.g., Voogt et al., 2011), and trust (e.g., Bolam, McMahon, Stoll, Thomas, & Wallace, 2005; Katz & Earl, 2010; Stoll et al., 2006). All of the identified elements can be assumed to be connected to each other. A change in any of the elements invites changes in the other elements. This means that the various characteristics are intertwined and do not operate separately (Bolam et al., 2005; Sutherland & Katz, 2005).

Networked PLCs

Strong and sustainable PLCs learn from the outside as well as the inside (Bolam et al., 2005; Hargreaves, 2007). Future research and experimentation, according to Chapman (2014), should therefore examine the successful structures and processes associated with between-school improvement. Also, system-wide change needs entire system collaboration and networking (Harris & Jones, 2010). Networks of schools may mobilize a wider range of resources and expertise than single schools, may provide greater opportunities for both self-reflection and collective reflection on practice, and may increase engagement with more challenging and interactive forms of professional learning (e.g., Hargreaves, 2007; Katz et al., 2008; Lieberman, 2000). For networked PLCs, professional learning is assumed to develop in a comparable way to within-school PLCs. Schools can "upload" their ideas and practices into the PLC, depending on the strength of the attachment between the school and the PLC. Likewise, schools can obtain ideas and practices from the PLC for knowledge creation and sharing within the school (Katz & Earl, 2010). The individuals can be seen as the connector of schools to the PLCs through active participation (Bolam et al., 2005; Katz & Earl, 2010). Therefore, networked PLCs could be an interesting option for enhancing teachers' professional learning and hence, student achievement.

There is, however, little systematic research available about the way in which PLCs in general work in terms of their key features and their effects (Katz & Earl, 2010; Vescio et al., 2008), and the support for networked PLCs remains inconclusive (Chapman, 2008; Harris & Jones, 2010). The value for school-to-school networking has been questioned. Researchers mention the lack of detail in the espoused

policies; the costly, complex structures; and the lack of empirical evidence for school improvement (Chapman, 2014; Sammons, Mujtaba, Earl, & Gu, 2007). The shift in emphasis from school improvement within the school to between schools (and beyond school) is also complicated by the challenge of working across organizational, geographical, cultural, and professional boundaries (Chapman, 2014; Harris & Jones, 2010).

Teacher Learning

Teacher professional learning is broadly defined in the educational literature. It refers to learning resulting from any activity that is intended to prepare teachers for improved performance in present or future practice (see Desimone, 2009; Desimone, Smith, & Phillips, 2013), ranging from "one-shot" workshops to long-term, intensive programs. Teachers collaborating in PLCs is one way of teacher learning (e.g., Katz & Earl, 2010; Stoll et al., 2006; Vescio et al., 2008), that is on the more intensive, long-term side of the continuum. Desimone et al. (2013) define a conceptual framework for professional learning and distinguish two central components (Figure 1).

The first component recognizes a set of critical features that define effective professional learning (Figure 1). General characteristics of teacher professional development by participating in PLCs, related to critical features for effective learning are, for example: collaboration; relation to teachers' own daily practice; focus on student learning; and participation over a longer period of time (i.e., at least one school year) (e.g., Katz & Earl, 2010; van Veen, Zwart, Meirink, & Verloop, 2010). The second critical feature follows an operational theory of how professional learning works to influence teacher and student outcomes (Desimone et al., 2013). The core theory of action is described in Figure 1.

Demonstrating the relationship between teachers' professional learning and student achievement is a great challenge (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Before student learning can be improved, teachers need to have developed the related knowledge, skills, and attitudes and need to have applied them to actually improve student learning (Desimone et al., 2013). Desimone et al.'s (2013) framework implies there are subsequent levels of professional learning effects (cf. Guskey, 2002; Kirkpatrick, 1996). In the context of networked PLCs, the first level refers to how participants feel about various aspects of professional learning, that is, their satisfaction with the process and results. Level 2 relates to participants' learning within networked PLCs, in terms of acquired knowledge and skills and changes in attitude due to professional learning. Level 3 refers to the participants' changed behavior following PLC participation, that is, the application of the acquired knowledge, skills (and attitude) to their own practice. Finally, Level 4 concerns the final results for student learning that occur due to these changes in learning and behavior (Desimone et al., 2013; Guskey, 2002; Kirkpatrick, 1996).

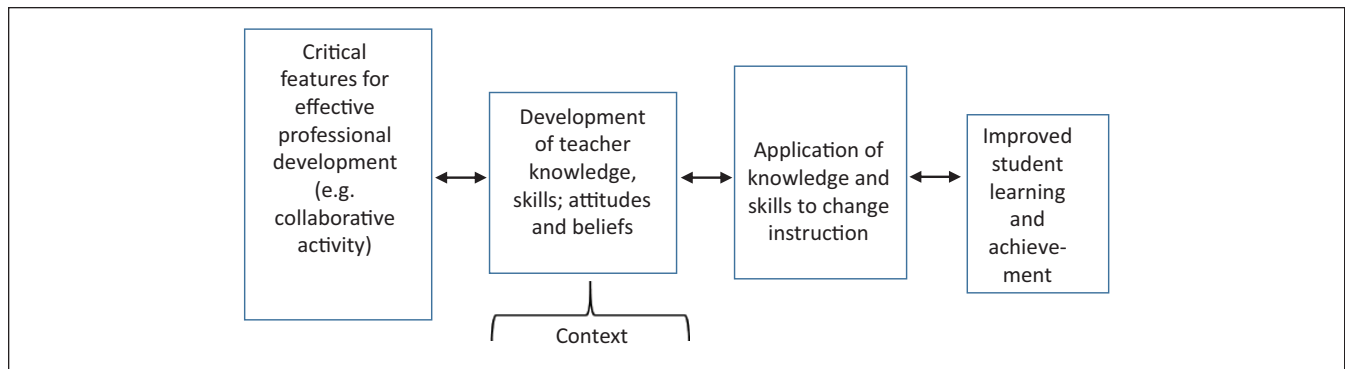


Figure 1. Conceptual model for teacher professional learning (based on Desimone et al., 2013).

The aim of the current study is to examine the effects of networked PLCs on professional learning of teachers, as the teachers are the connectors of schools to the PLCs and key figures for school improvement (e.g., Katz & Earl, 2010), and eventually system improvement. Teacher professional learning programs generally share the goal of changing teachers' behavior, knowledge, and attitude, with the ultimate goal of improving student achievement (Desimone et al., 2013; Guskey, 2002). The PLCs in this project have a large variety of goals, intended learning outcomes (for both teachers and students), and consist of participating teachers from different schools. Therefore, the focus is on effects in terms of the first three levels of teacher professional learning: What are the effects of participating in a networked PLC on teachers' professional learning in terms of their satisfaction; knowledge, skills, and attitude; and application?

1. Satisfaction: What are the effects in terms of teachers' satisfaction with the process and outcomes of the PLC?
2. Knowledge, skills, and attitude: What are the effects in terms of changes in teachers' pedagogical/instructional knowledge related to the subject of the PLC; in their skills associated with the PLC's subject; and in the professionalism of their attitude toward the PLC's subject?
3. Application to practice: What are the effects in terms of teachers' application of the knowledge, skills, products, or approach they have developed through participation in the PLC?

Context of the Project

Current practices in secondary education in the Netherlands are such that collaboration between teachers is often rather poor (Brouwer, 2011). To address this, the Dutch Ministry of Education supported the project "Pilots for the development of PLCs." This ongoing project is aimed at setting up, guiding, and researching PLCs consisting of teachers from different schools.

A total of 23 PLCs from different regions in the Netherlands are participating in this project, receiving guidance from an external coach (either from a university teacher training program or through cooperation between a university and an applied sciences teacher training program). The external coaches had three different roles. As teacher educators, they fulfilled an expert role. For example, they gave presentations on content-specific topics and could be approached for such questions. Second, they coached the participants. For example, they monitored the progress of subgroups and stimulated them to reflect on learning experiences. Finally, they coordinated the PLC, as they took the lead in organizing the content of each meeting, and arranged the locations at which participants meet. The criteria for setting up the PLCs participating in the project were that they

- Included participating teachers from different schools with a shared teaching subject,
- Consisted of a mix of teachers who had graduated from higher vocational and from university teacher education,
- Were working on a specific product or approach as the main outcome of the PLC,
- Physically came together for a meeting regularly (at least once a month) for at least one year, and
- Were guided by at least one teaching subject-expert (the external coach) in the area of research, curriculum design, or improving instructional approach.

The networked PLCs started working together in either 2013 or 2014. They could freely determine their goals and subject. Each PLC met at least once per month. The subjects chosen by the PLCs can be categorized along three main themes:

- Teachers' professional attitude, for example, teachers' research skills (4 PLCs). Activities in this category consisted in general of presentations, workshops, and methods to address teachers' research skills (e.g., questionnaire construction, data analysis).

- The development of new lesson material, for example, new lesson material for reading or for information and communication technology (ICT) in the classroom (16 PLCs). Main activities consisted of lesson material development in groups, based on experience exchange between participants and content-specific presentations and workshops (e.g., guest speakers, teacher educator). Skills that are addressed here are, for example, data-based decision making and material development skills.
- A combination of professional attitude and development of lesson material, aiming to develop new lessons through a lesson study approach (3 PLCs). Whole group meetings were organized by means of presentations, workshops, and group work, in which lesson series were developed (evidence-based) and adjusted. Subgroup meetings consisted of the application of the lesson material/series by each teacher at their own school, while the other group members were observing students' reactions. Research skills are addressed here, as well as skills to develop materials and observe students, for example.

Each PLC has their own specific goals and intended outcomes. These range from "promoting a critical and reflective attitude in teachers" to "developing new lesson material for science subjects."

Research Design and Method

Mixed-Methods Approach

Studies published in the last decade have either investigated the characteristics of PLCs based on qualitative designs or examined their relationships and effects by performing quantitative analyses (Lomos et al., 2011). To understand teacher learning, it must be studied in multiple contexts, taking into account both the individuals and the social systems in which they are participants (Borko, 2004). Researchers should use multiple sources of evidence in terms of data, methods, and preferably also investigators' triangulation to reduce bias (Poortman & Schildkamp, 2011).

Consequently, we made use of a mixed-methods approach. To report outcomes regarding teacher professional learning at the levels of satisfaction, knowledge and skills, attitudes, and behaviors for a large number of teachers participating in 23 PLCs, we made use of a questionnaire. In addition, according to Coenders, Terlouw, Dijkstra, and Pieters (2010), professional growth is a complex personal process best described using qualitative studies. Moreover, Bolam et al. (2005) reported that even though PLCs have common characteristics, the practical implications for developing a PLC can only be understood and worked out in response to the specific conditions. In our study, PLCs varied in terms of main goal, total number of participants, duration, and region.

Therefore, five PLCs representing five different regions in the Netherlands were studied more intensively using qualitative data, to describe the effects of specific PLCs in more detail. We selected one PLC concerning teachers' professional attitude, one that focused on the Lesson Study approach, and three in which the focus is on the development of lesson material. Finally, the external coaches from all 23 PLCs were asked to keep a log in which additional information from the external coach's perspective could be monitored (e.g., about outcomes of the meeting, what went well, and what could be improved). Thus, to monitor the outcomes of networked PLCs, a survey approach was applied in combination with qualitative interviews, supplemented with the coaches' logs. This means we have applied data triangulation by using multiple sources (both teachers and external coaches), multiple methods (a quantitative survey and qualitative interviews and logs), and partly multiple investigators (for conducting the interviews and to determine interrater agreement for the qualitative data).

Respondents

Twenty-three PLCs from 11 different regions in the Netherlands are participating in this project ($n = 276$ teachers in total). The number of teacher participants per PLC varies from 4 to 20. Each PLC has at least one external coach. Teachers are the main respondents for this study, as we are mainly interested in their professional learning. However, the external PLC coaches are also involved as respondents, both for (data) triangulation purposes and for more detailed examination of effects. In total, 33 external coaches were involved as respondents. Of these coaches, 23 are working at a university teacher training program; the other coaches work at a university for applied sciences teacher training program. The coaches typically have a background in the subject the PLC is focused on (see also 'Context of the project').

Instruments

Measurements addressing each specific aspect of the overarching research question are described below. All three levels of professional learning (Desimone et al., 2013) were measured by each instrument.

Questionnaire. A questionnaire was developed to obtain quantitative data describing the effects of the PLCs in this project. It focused on participants' perceptions of the extent to which intended outcomes of the professional development were realized. The questionnaire included questions regarding the different levels of effects as described in the theoretical framework: satisfaction; knowledge, skills, and attitude; and application to practice. The questionnaire was administered to the participants after 6 to 12 months of PLC participation, as the PLCs started at different points in time, and the

questionnaire was administered approximately 12 months after the first PLC started. However, all participants were in the first, starter stage of PLC development (Bolam et al., 2005). Answers could be given on a 5-point Likert-type scale.

For the *teacher satisfaction* level, we included five items about teachers' satisfaction regarding team process and progress (e.g., "Our PLC did not accomplish as much as I had hoped for before I started in the PLC") and three items on the products (e.g., "Our PLC resulted in good quality products"). These items were based on a questionnaire developed and pilot-tested for a study of teacher design teams (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015) and items used in a questionnaire about teachers' satisfaction with a particular type of PLC on data use (Ebbeler, Poortman, Schildkamp, & Pieters, 2017).

Regarding *knowledge and skills*, we included nine items about the extent to which teachers perceived that they had gained pedagogical/instructional knowledge and skills, and knowledge about the PLC subject (e.g., "Through participation in the PLC I learned how to design relevant material"; Binkhorst et al., 2015; Ebbeler et al., 2017) and eight items about teachers' professional attitude. The measure for professional attitude was based on the validated professional attitude scale developed by van Aalderen-Smeets and Walma van der Molen (2013). They distinguished three different dimensions: cognitive beliefs, affective states, and perceived control, of which we included questions regarding affective states and perceived control. Items measuring professional attitude as a result of PLC participation consisted of three items for enjoyment (e.g., "Since PLC participation, I like the subject more") and three items for self-efficacy (e.g., "Since PLC participation I am better able to answer relevant questions").

Regarding *application* of teachers' knowledge, skills, product, or approach we included one item asking teachers about the products they gained of or produced in the PLC. Also, we included items that referred to the extent to which the teacher felt they had changed their teaching practice (five items, e.g., "Since PLC participation, I have improved my educational practice; Binkhorst et al., 2015) and/or research practice (five items, e.g., "After I started participating in the PLC, I conducted a study of the literature") changed since the start of the PLC.

Factor and reliability analyses. A principal axis factor analysis was conducted on the intended scales for the different subscales of professional learning, with varimax rotation (Field, 2013). The Kaiser–Meyer–Okun (KMO) measure verified the sampling adequacy for the analysis (KMO = 0.86). An initial analysis was run to obtain eigenvalues for each factor in the data. Four factors had eigenvalues over Kaiser's criterion of 1, and in combination explained 53.96% of the variance. The items that cluster on the same factor suggest that Factor 1 represents knowledge and skills, Factor 2 represents satisfaction, Factor 3 represents attitude, and Factor 4

represents application. One item for satisfaction and one item for application (research practice) loaded lower than 0.40 and were deleted from the scales. For knowledge and skills, one item that loaded below 0.40 was retained for analyses, based on theoretical considerations. Reliability of the scales was "sufficient" to "good" (Table 1).

Qualitative Interviews and Logs

Qualitative data were collected by means of audiotaped individual interviews with three teachers and an external coach (per PLC) in the case studies. The teachers for the interviews were a convenience sample. The duration of the interviews was 30 min on average, and they were conducted by the researchers using an interview protocol. Teachers were asked about their own perceptions of the four outcome measures. External coaches were asked about what they experienced during the meetings regarding what knowledge and skills were acquainted by the participants, if and how their attitude changed and what was reported regarding the application to practice by the teachers in the meetings. For evaluation of teacher professional learning outcomes, open-ended questions were asked about participants' satisfaction regarding the material, process, and progress (e.g., "How satisfied are you about organization of the PLC meetings?" and "How satisfied are you about the progress of the PLC?"). In addition, "overall satisfaction with the PLC project so far" was addressed to both the teachers and external coaches (from their own perspectives). Furthermore, teachers were questioned about their satisfaction regarding the guidance provided by the external coach. Both teachers and coaches were asked open-ended questions regarding teachers' knowledge, skills, and application related to the professional learning outcomes (e.g., "What knowledge and skills have you developed by participating in this PLC?" and "To what extent have you applied the knowledge and skills in your own practice" "In which way?"). After having answered this general question to start with, questions became more in-depth, by asking the how and why of interviewees' responses.

As a complement to the questionnaires and interviews, we collected data with a log, to be filled out by the external coaches of all PLCs after each meeting. In these logs, external coaches described the goal, activities, the products (knowledge, skills, attitude), what was agreed on for the next time, and an evaluation or reflection on the meeting by the external coach per meeting. To put these logs in a context, external coaches additionally reported on background information, such as the number of participants and the purpose of the meeting.

We used a mixed-methods approach to examine the effects of networked PLCs (Creswell & Plano Clark, 2011). First, we analyzed the results from the questionnaire. Then, we used the findings from the interviews and observations to explain or contradict the findings from the questionnaire. Also, the data collected from the external coaches (logs and

Table 1. Summary of Principal Axis Factor Analysis With Varimax Rotation.

| Item | Knowledge and skills | Satisfaction | Attitude | Application (research practice) |
|---|----------------------|--------------|----------|------------------------------------|
| (In) our PLC . . . | | | | |
| . . . uses the meetings efficiently | | .68 | | |
| . . . works together effectively | | .71 | | |
| . . . does a lot of work | | .75 | | |
| . . . did not achieve as much as I hoped at forehand | | .53 | | |
| . . . enjoys the meetings a lot | | .32 | | |
| . . . are the products of good quality | | .65 | | |
| . . . are the products practically useful | | .59 | | |
| . . . are recent content-specific insights included | | .59 | | |
| In this PLC | | | | |
| I acquired skills to improve my teaching practice | .57 | | | |
| I acquired skills to improve my research practice | .32 | | | |
| I learned how to develop relevant material | .54 | | | |
| I acquired new didactical insights | .47 | | | |
| I acquired new pedagogical knowledge | .48 | | | |
| I developed my critical-reflective attitude | .46 | | | |
| Since the PLC started | | | | |
| I enjoy the subject more | | | .69 | |
| I am better able to answer relevant questions | | | .44 | |
| I am better able to bring the subject into my own practice | | | .66 | |
| The subject has become more important to me | | | .86 | |
| The subject has become more interesting to me | | | .87 | |
| Since PLC participation^a | | | | |
| . . . I have improved my teaching practice | .80 | | | |
| . . . I make use of more research-based lessons | .58 | | | |
| . . . I spend more time on the coherence between related subjects | .57 | | | |
| . . . I make (more) use of appealing contexts | .67 | | | |
| . . . I experiment (more) with new lessons | .72 | | | |
| . . . I conducted a literature study | | | | .69 |
| . . . I have taken questionnaires or interviews | | | | .45 |
| . . . I have worked on a research proposal | | | | .78 |
| . . . I have improved my research practice | | | | .86 |
| % of variance | 36.4 | 7.8 | 5.7 | 4.1 |
| α | .81 | .87 | .88 | .81 |

Note. Rotated factor loading. PLC = professional learning communities.

^aApplication (teaching practice) loaded on the knowledge and skills factor and was extracted from this scale based on theoretical considerations ($\alpha = .87$).

interviews) were applied to confirm or contradict the results we found on the teachers. Finally, we used the qualitative results to illustrate the quantitative results.

Analyses

Regarding the effects of networked PLCs on teachers' professional learning outcomes, we conducted descriptive analyses presenting the mean, standard deviation, minimum and maximum, and median of the scores for the questionnaire scales for satisfaction, knowledge and skills, attitudes, and application. To examine differences between the three main themes that PLCs were addressing, we conducted ANOVAs

for the effect measures. All analyses were performed using SPSS 22.0.

The interview data were transcribed verbatim based on the audiotapes. The transcripts and coaches' logs were coded using ATLAS.ti. A coding schema was developed by the researchers, consistent with the theoretical framework (Table 2). To assess its reliability, three researchers coded approximately 10% of the data together in two rounds. The interrater agreement was substantial (Cohen's Kappa = 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 transcript was coded for answers about teachers' satisfaction; knowledge, skills,

Table 2. Coding Scheme.

| Code | Indicators |
|---------------------------------|--|
| Satisfaction | Satisfaction of teachers of PLC participation (e.g., collaboration, contents, leadership, materials, progress) |
| Knowledge, skills, and attitude | The PLC-related knowledge/insights, skills, and/ or attitude of teachers |
| Application | The actual application of developed knowledge, skills, and attitude (e.g., of the developed approach, or material) by PLC participants in their daily work |
| PLC-specific goals | Achieved aim in relation to the teachers' professional attitude Achieved aim in relation to the development and design of new material or approaches |

Note. PLC = professional learning communities.

and attitude; and application. The results were compared and summarized per category (e.g., satisfaction) for the interviewees and logs per PLC, and subsequently overall, in which a distinction was made between teachers' and external coaches' perspectives. Subsequently, quantitative data were analyzed and were illustrated and explained by means of the qualitative data from both perspectives.

Results

This section starts with a description of the baseline characteristics of the PLCs and their participants. Then, the quantitative and qualitative results are described per aspect of the professional learning outcomes evaluated (satisfaction; knowledge, skills, and attitude; and application to practice). Finally, differences between groups are considered.

Survey Respondents

Characteristics for the teacher respondents to the survey are shown in Table 3. The survey was sent to all 23 PLCs, a total of 276 teachers. A total of 151 teachers (54.7%), representing 21 PLCs (91.3%), participated in the survey. The reported attendance rate from the PLC meetings varied from 67.5% to 95.2%. There was one PLC that reported more than the planned number of participants as they invited colleagues to attend the PLC.

Effects of Networked PLCs on Teacher Professional Development

Satisfaction

Questionnaire. Results from the questionnaire showed that the mean score for satisfaction was 3.64 ($SD = 0.58$) on a 5-point Likert-type scale. This means that responses were between "neutral" and "agree" on statements such as, "Our PLC collaborates effectively" and "In our PLC, the products can be used in practice."

Interviews and logs. Data from the interviews showed what teachers were enthusiastic about and involved in regarding the PLC and its subject. One participant reported, for exam-

Table 3. Participant Characteristics for the 21 PLCs Responding to the Survey.

| | |
|---|---|
| Teachers | 151 |
| School locations | 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% |
| Both | 52.2% |
| Main subjects | |
| Physics | 18.1% |
| Geometry | 15.2% |
| Mathematics | 13.0% |
| Teaching level | |
| Grade 1 ^a | 8.3% |
| Grade 2 | 41.7% |
| Teaching experience (in years) | $M = 16.12$ ($SD = 10.48$) |
| Time spent on PLC per month (in days) | $M = 9.37$ ($SD = 4.68$), median = 10 |
| Time provided by the school per month (in days) | $M = 8.50$ ($SD = 15.91$), median = 5 |

Note. PLC = professional learning communities.

^aGrade 2 teachers are qualified to teach pre-vocational education and the first 3 years of senior general secondary education and pre-university education. Grade 1 teachers are also qualified to teach the final years of senior general and pre-university education.

ple, "I think it's a great development. It has finally come this far that it has gotten more substance whereby the board, and the school, . . . , are more willing to put in more energy." They experienced the PLC as being stimulating and informative, as reported by this participant: "I enjoy and think it's a great benefit to hear how everything works at other schools and what they do and what they don't do, and which problems they encounter. A little collegial exchange." A common positive remark from teachers was the opportunity to exchange

information with teachers from other schools in the PLC. Suggested adjustments might show why the mean score for the questionnaire was not more than moderate. These suggestions included mostly organizational aspects and consisted, for example, of improvements for time management during meetings, the digital environments in which information was exchanged, and the structure of the guidance by the external coaches. About the guidance, one participant reported, "The external coach sometimes talks about all kind of things and he finds it hard to keep up with a schedule. I need structured planning that everybody adheres to." Also, the lack of time (provided by the schools) for proper preparation for the PLC meetings was mentioned often in the interviews by teachers and coaches, as was the varying (active) participation by teachers in the PLC.

External coaches confirmed in the logs that teachers were enthusiastic during meetings, as these quotes from two different coaches illustrate: "Teachers felt inspired"; "Teachers said it was 'wonderful' to work together with motivated colleagues from other schools." They also reported that participants wanted "more time to work on their own studies during the meetings."

Knowledge, Skills, and Attitude Following PLC Participation

Knowledge and skills

Questionnaire. Results showed that the mean score for acquired knowledge and skills (in the PLC) was 3.47 ($SD = 0.64$) on a 5-point Likert-type scale. This means their responses were, on average, between "neutral" and "agree" to statements such as "Since PLC participation, I have learned how to design relevant material" and "Since PLC participation, I have acquired new pedagogical knowledge." Two participants reported not having acquired any knowledge and skills at all following PLC participation.

Interviews and logs. Awareness of knowledge acquired through PLC participation was often mentioned in the interviews by both teachers and external coaches. This awareness mostly consisted of insight about, knowledge of, and a renewed look on the subject addressed by the PLCs, and their own teaching practice. This is illustrated by one participant's comment as follows: "This (the PLC) highly stimulates out of the box thinking about what I can do differently, by means of others' knowledge and other ways to do that." Gaining ideas and insight into the working methods at other schools and subject-specific knowledge were also mentioned by teachers in the interviews. Specific examples of acquired knowledge reported by PLC participants are knowledge about (the application of) self-evaluation instruments for students in a PLC about differentiation for English students in bilingual education, and knowledge about (the design of) four different research instruments and the construction of a coding scheme. Both examples were confirmed by the

external coaches in the interviews. Acquired skills included developing research instruments, lesson series, and subject-specific skills. Regarding knowledge and skills characteristic for *networked* PLCs, one participant said in an interview, "All roads lead to Rome and . . . maybe there are people with better ideas." Another participant reported, for example, ". . . But what it adds is that you get to know what other schools do, how different, which systems they use, if they exchange things with other schools, the organization etcetera, because those data are very sensitive indeed." Differences within and between PLCs in the degree and type of knowledge and skills acquired might also explain here why the questionnaire results were moderate for knowledge and skills. For example, one teacher reported having gained greater insight; however, he did not acquire any extra skills. One teacher reported having learned and adopted a goal-oriented and structured way of working, and another teacher in the same PLC reported only having gained some new ideas.

All external coaches reported in the logs that participants in their PLCs acquired some sort of knowledge or skills. These mainly consisted of awareness, gaining ideas, insight into the working methods at other schools, and subject-specific knowledge. Regarding awareness, a coach reported, for example, "For some teachers it was an eye-opener how you can involve students more actively in the lessons." Regarding insight into ways of working at other schools, a coach reported, "The teachers have learnt about what happens in their respective schools with regard to their subject."

Professional attitude

Questionnaire. Results showed that the mean score for professional attitude was 3.67 ($SD = 0.65$) on a 5-point Likert-type scale. This means participants responded between "neutral" and "agree" to statements such as "Since PLC participation, I like the subject more" and "Since PLC participation, I am more able to answer relevant questions."

Interviews and logs. An interviewed teacher thought it is *very pleasant* to prepare lessons with multiple colleagues, instead of sitting at home and trying to think of the lesson design: "That you have a discussion first, what do we actually want to achieve with this lesson, what is our goal? . . . We should also have time for that within our school." This teacher has learnt that it is important to not only think about the curriculum and exam demands, but also to spend more time on how to achieve this in the lessons. A teacher in the same PLC reported that she is better able to justify why she does things in a certain way. Teachers did not only report to have developed in this sense, however. A teacher from a different PLC, for example, thought "it is more about developing products [lesson material]," and felt he had not really further developed his professional attitude. Correspondingly, the teachers' professional attitude was not mentioned much in the logs. Most remarks that did address attitude reported the development of a critical attitude during PLC meetings

and how this should be improved. An external coach reported in the logs, for example, “Participants should be much more critical towards each other’s work. I notice that critical reading is something that needs to be learned. More time needs to be spent next year on this.” Another external coach reported that teachers referred to external causes of problems in their teaching practice, instead of referring to their own actions: “Causes of problems with ICT in their teaching practices are mainly linked to the organization and colleagues and not yet to their own actions and the way in which ICT can contribute to learning.”

Application of knowledge and skills

Questionnaire. Results showed a mean score of 3.45 ($SD = 0.74$) for application of knowledge and skills in their teaching practice (average calculated only for respondents who did not indicate “not applicable,” $n = 134$) on a 5-point Likert-type scale. This means that participants responded between “neutral” and “agree” to statements such as, “Since PLC participation, I have improved my lesson practice” and “Since PLC participation, I experiment (more) with new teaching practices.” For application to research practice (average calculated only for respondents who did not indicate “not applicable,” $n = 125$), the mean was 3.06 ($SD = 0.97$). This means that participants responded on average “neutral” to statements such as, “Since PLC participation, I worked on a research proposal” and “Since PLC participation I improved my research practice.” Furthermore, participants reported several products from their PLC participation. Among all participants responding to the survey, lesson material was mentioned most often (65.6%), followed by the design of a series of lessons (41.7%). Research instruments (36.4%), improving research practices (33.8%) and designing a teachers’ manual (22.5%) were mentioned next. Only four participants (2.6%) reported not having developed products following PLC participation.

Interviews and logs. In the interviews, one teacher reported that material developed during PLC meetings was applied by themselves and colleagues, and multiple teachers reported having passed on the information from the PLC meetings to a work group at their own school. This was illustrated by one participant in an interview: “We have a little work group at school with people who have been involved with this academic teaching school before. Who have followed a sort of research training and got the assignment from the direction of our school to at least work out a research plan, to which we can say ‘yes’ later on.” Also, some teachers expressed their concerns about application of the material in the schools, as was reported by the following participant: “I’m afraid it just costs too much time. . . . it is of course a very intensive way of, especially time-consuming way of developing teaching material.” In addition, an external coach reported the following: “It is really hard to implement the contents of the PLC within the school.

The participants within this PLC do not seem to be very keen on it, as they think they have not done or reached that much. One or two people shared some products with their department, but an actual presentation of their research, is something different.” Examples of specific products were: evaluated lessons and -formats with corresponding video recordings of these lessons, in a PLC about new lesson formats with modern information technologies; differentiated tasks for students adapted to the PLC participants’ own context including self-evaluation instruments and rubrics, in a PLC regarding differentiation in English for bilingual education; the development and evaluation of teaching assignments for the assessment of geographical skills, in a PLC regarding higher-level thinking skills for geography; and design research by participants about how to provide insight to students on the contents of certain subject-specific skills, in a PLC regarding writing tasks for social studies.

Differences between groups. Statistical differences between the three themes addressed by the PLCs were explored by means of ANOVA analyses on the professional learning scales from the questionnaire. The mean score for application in research practice was significantly higher for PLCs pursuing the theme of research skills than for PLCs addressing both other themes. No significant differences were found for the other outcome measures.

Discussion

Networked PLCs seem promising in the literature. However, the challenge of implementing these between-school PLCs is recognized and may raise concerns regarding its effectiveness. This study presented the perceived effects of 23 networked PLCs in the Netherlands. The research question relates to the effects of networked PLCs in terms of teacher professional learning, as teachers are the connectors of schools to the PLCs and key figures for school improvement (e.g., Katz & Earl, 2010). Despite the identified limitations and challenges of networked PLCs, we found moderately positive to positive results on teachers’ perceptions of professional learning.

Teachers in the networked PLCs in this study were enthusiastic; however, organizational aspects (e.g., time management in meetings, PLC guidance), the lack of time and high work load, and the varying level of (active) participation by other members appeared to negatively influence the participants’ satisfaction. The interview and log results appear to provide more insight into why the questionnaire results were all between neutral and positive. The relatively high average number of hours spent on the PLC per month is striking (Table 3), compared with other professional learning initiatives which generally take less time. Although some respondents reported a lack of time, enthusiasm and motivation for the PLC seemed to be reflected in this amount of time spent by PLC participants. For networked PLCs specifically, this

enthusiasm and motivation may partly be explained by the highly valued collegial exchange with other schools.

The teachers responded moderately positive to questions regarding their acquired knowledge and skills. These findings were confirmed by the external coaches: on average, every participant did acquire some sort of knowledge or skills. Awareness of the subject and their own teaching or research practice appeared to be a common aspect of knowledge obtained from the PLC according to teachers and external coaches, although the extent to and the type of knowledge and skills varied within as well as between as within PLCs. Despite professional, geographical, organizational, and cultural challenges, participants professionally developed in terms of knowledge and skills. Moreover, they benefited from the network-specific characteristics as participants reported that they learned about working methods and processes in other schools. Teachers' professional attitude following PLC participation also tended to develop positively. The awareness of the subject and the teacher's own teaching and research practice may have contributed to this professional attitude.

Regarding the application of knowledge, skills, product, or approach to practice, we found that almost all participants (97.4%) reported having produced materials during PLC activities. However, participants responded "only" moderately positive on this scale in the questionnaire. This discrepancy may be explained by the assumption that most teachers applied the knowledge and skills they developed in creating products, but did not automatically apply these products, knowledge, and skills in their own practice (yet). For their research practice, perceptions of the application of knowledge and skills were less positive, and logically, higher for the PLCs addressing the theme of research compared with those addressing the other themes.

Focused on the characteristics specific for networked PLCs, this study shows that the transfer of knowledge and skills from the PLC to the school context has been initiated, and vice versa: knowledge and skills from the schools have been brought into the PLC. In addition, we found indications that knowledge, skills, and products were shared within the school by means of workgroups, or material exchange with colleagues. In terms of the goals and benefits of networked PLCs, the first steps toward changes on school level seem to have been made. Implications for future research and practice should focus how this progress develops on the long term between and within the schools, and how this could be optimized to sustain change in educational systems (Chapman, 2014).

Desimone (2009) states that professional learning is often ineffective in terms of improving the knowledge, skills, and attitude of the receiver. In the context of networked PLCs, teachers in this study had mixed perceptions of the effects of professional learning. According to Bolam et al. (2005), three different stages of PLC development can be distinguished: starter, developer, and mature. The PLCs in this

study are, based on their duration, in the starter stage of development. This means, for example, that participants may be less involved with PLC activities compared with the latter two stages (Bolam et al., 2005). A longer duration and active participation in the PLC could possibly improve effectiveness.

Furthermore, the qualitative data gave indications of certain factors that may have influenced effects. These factors should shape effective professional learning, according to Desimone et al. (2013) as described in Figure 1. Teachers reported issues regarding facilitation, PLC guidance, and group characteristics (e.g., varying participation at meetings) that could have negatively influenced their satisfaction, and consequently the next levels of the professional learning process. The literature shows that multiple individual and organizational factors are important for achieving effects on both the teacher and student level (Chapman, 2008; Desimone et al., 2013; Katz & Earl, 2010; Lomos et al., 2011; Stoll et al., 2006; Vescio et al., 2008). Also, the strength of attachment between the schools and the network may play a crucial role here. Katz and Earl (2010) found, for example, correlations between the strength of attachment and changes in thinking and practice. The strength of attachment can be a function of multiple teachers from one school engaging in the network, or it can be covered by a smaller number of "boundary spanners" (Katz & Earl, 2010, p. 39). These people form the link between the school and the PLC and are key figures in the process of knowledge sharing. In the current study, mostly one or two people from one school participate in the network. This means that, to accomplish school- and even system improvement, PLC participants should be able to broker the skills and knowledge they have learned besides professionally developing themselves. Further research should focus on the relevant factors for professional learning in *networked* PLCs, to be able to enhance professional learning and examine the strength of attachment to the network for knowledge brokerage across the schools and systems eventually.

Limitations

A limitation of this study is that we measured effects based on teachers' and coaches' perceptions. However, to reduce bias, we applied a mixed-methods methodology in which we triangulated our quantitative and qualitative data in terms of involving both teachers and coaches as respondents and using not only questionnaires but also interviews and logs. Second, we studied the effects of 23 PLCs varying in goals, contents, participants, and so on. Therefore, results remained general and data from the case studies were used to provide more concrete examples. Third, although we found effects on teachers' perceptions of satisfaction, knowledge, skills, attitude, and application to practice in the context of networked PLCs, the next step is to examine effects on student achievement results.

Conclusion

Chapman (2008) states that despite much optimism regarding networked PLCs, support for their effects remains inconclusive (see also Sammons et al., 2007). There is a need for more research relating to both impact and processes (Chapman & Muijs, 2014). In the present study, moderately positive effects on teachers' perception of acquired knowledge and skills, attitudes, and the application of knowledge and skills for practice were found. On one hand, there is room for improvement. The interviews and logs appear to confirm that although respondents report positive outcomes, they are also critical about organizational aspects, guidance, and developing knowledge and skills. Moreover, effects of these networked PLCs on school- and system improvement are still questionable: the transfer of knowledge and skills has been initiated, but not yet naturally.

According to DuFour (2004, p. 6), "the movement to develop professional learning communities" needs to reflect critically on the concept's merits, to make sure that PLCs indeed support schools and improve education. Although the PLC may be a powerful way of working together that may greatly promote school improvement, it is hard work not only to initiate but also to sustain the concept (DuFour, 2004). On the other hand, despite their relatively early stage, many PLC participants in this study already developed products such as research instruments, lesson materials, or lesson series. This is not considered a sufficient but certainly a necessary condition for ultimately also improving student learning. Important questions for further research, therefore, are whether these PLCs indeed contribute to improved student learning, and which factors influence these PLC outcomes in what way.

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