



A qualitative analysis of teacher design teams: In-depth insights into their process and links with their outcomes



F. Binkhorst^{a,*}, C.L. Poortman^a, W.R. van Joolingen^b

^a ELAN, Department of Teacher Development, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands

^b Freudenthal Institute for Science and Mathematics Education, Utrecht University, P.O. Box 85.170, 3508 AD Utrecht, The Netherlands

ARTICLE INFO

Keywords:

Professional development
Teacher teams
Team leadership
Ownership
Qualitative research

ABSTRACT

Teacher Design Teams (TDTs) are professional learning communities in which teachers collaborate to (re)design innovative educational materials. TDTs can contribute to teachers' professional growth. Furthermore, engaging teachers in the design process could create ownership, increasing the likelihood that teachers actually use the innovative materials in practice. In this study, we aimed to obtain in-depth insights into the TDT process and to identify possible links with the outcomes. We studied three cases of TDTs, collecting qualitative data from multiple perspectives. We found that the perceived outcomes of the TDTs were mixed. The leadership style appeared to play an important role in shaping the process and hence the perceived outcomes. To improve the outcomes of future TDTs, insights from this study suggest that team coaches should provide more structure and clarity during the process. At the same time, the coaches should create an atmosphere in which participants can take the initiative.

1. Introduction

Professional development programs for teachers involving collaboration are considered to be highly effective, as they can build teachers' individual and collective capacities (Avalos, 2011; Crow & Pounder, 2000; Hardré et al., 2013; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; van Driel, Meirink, van Veen, & Zwart, 2012; van Veen, Zwart, Meirink, & Verloop, 2010). Therefore, the concept of Professional Learning Communities (PLCs) – which are groups of teachers focused on collaborative learning through sharing experiences and critical reflection – has received much attention in many countries (Stoll et al., 2006). Well-designed PLCs can contribute to improved teaching practice and student achievement (Vescio, Ross, & Adams, 2008). PLCs can either have participants from the same school (school-based PLCs) or participants from various schools (networked PLCs). Various studies have indicated that networked PLCs are needed for actual school improvement, as they have the potential to move beyond the knowledge that is available within a single school (Bryk, Gomez, & Grunow, 2011; Chapman, 2014; Hofman & Dijkstra, 2010).

A Teacher Design Team (TDT) is a specific type of PLC that can be defined as 'a group of at least two teachers, from the same or related subjects, working together on a regular basis, with the goal to (re)design and enact (a part of) their common curriculum' (Handelzalts, 2009). As with other types of PLCs, TDTs can be either school-based or

networked. Studies have shown that TDTs can contribute to teachers' professional development (Bakah, Voogt, & Pieters, 2012b; Kafyulilo, Fisser, & Voogt, 2014; Voogt et al., 2011). By sharing expertise and experiences while designing educational materials, teachers can gain new knowledge and skills and can use these to improve their overall teaching practice. Additionally, as teachers who participate in a TDT are engaging in designing concrete educational materials, they are not only exposed to new teaching practices, but also actively shape their teaching practice (Voogt et al., 2011). This is crucial for teachers, as designing materials is considered to be a core aspect of teachers' work (Carlgren, 1999). In particular, this is important in the case of educational innovations. The success of educational innovations largely rests on the shoulders of teachers, as they are expected to put the innovative ideas into practice (Huizinga, Handelzalts, Nieveen, & Voogt, 2013). Designing concrete educational materials in TDTs could create a sense of ownership of these innovations, which increases the likelihood that teachers would actually adapt their classroom practice accordingly (Bakah, Voogt, & Pieters, 2012a; Visser, Coenders, Terlouw, & Pieters, 2012; Wikeley, Stoll, Murillo, & De Jong, 2005). Therefore, TDTs can also contribute to sustainable implementation of educational innovations (Handelzalts, 2009; Johnson, Severance, Leary, & Miller, 2014; Mooney Simmie, 2007).

* Corresponding author.

E-mail addresses: f.binkhorst@utwente.nl (F. Binkhorst), c.l.poortman@utwente.nl (C.L. Poortman), w.r.vanjoolingen@uu.nl (W.R. van Joolingen).

1.1. Problem statement

As TDTs can yield both professional development and innovative educational materials, they can be very valuable for teachers. Although several studies have indicated how individual characteristics of TDTs can influence part of their outcomes (e.g. Boschman, McKenney, & Voogt, 2015; Huizinga, Handelzalts, Nieveen, & Voogt, 2014), there is little empirical research available that evaluates how the complete process of TDTs works and how aspects of the process are linked with their perceived outcomes in terms of both professional development and the designed material. More thorough, in-depth understandings of the TDT process and outcomes are required to evaluate how TDTs could best be organized to promote the outcomes of TDTs in the future. Therefore, the aim of the present study is to obtain in-depth insights into the TDT process and to explore potential links with the perceived outcomes of TDTs.

1.2. Theoretical framework

Several studies about TDTs and other types of (networked) PLCs have indicated essential characteristics and potential outcomes. In our previous study, we aggregated these findings and developed a descriptive framework that includes all key elements that are important for understanding the TDTs' process and outcomes (Binkhorst et al., 2015).

To address how the key elements of the process are related to the outcomes, the following theory of action for professional development can be used (Desimone, Smith, & Philips, 2013): (1) teachers experience professional development with effective features; (2) the professional development increases teachers' knowledge and skills and/or changes their attitudes and beliefs; (3) teachers apply their new knowledge, skills, attitudes and beliefs to improve their instruction, their pedagogy or both; and (4) these instructional changes foster increased student learning. In the context of TDTs, this means that teachers who participate in a TDT that includes effective features during the process can gain new knowledge and skills and use them to improve their teaching practice, which can foster increased student learning. Additionally, as TDTs are also focused on designing specific educational materials, we use an analogous theory of action: TDTs that include effective features can also result in new educational materials that can be used in practice.

In this section, we will use the descriptive framework from our previous study to first discuss the potential outcomes of TDTs in terms of *professional development*, the designed material and the *sense of ownership* of the TDT. Subsequently, we will address the key elements of the TDT process, including the *process features* (i.e., team interaction, goal alignment, activities and organization of the TDT) and the *leadership style*. The descriptive framework is depicted in Fig. 1.

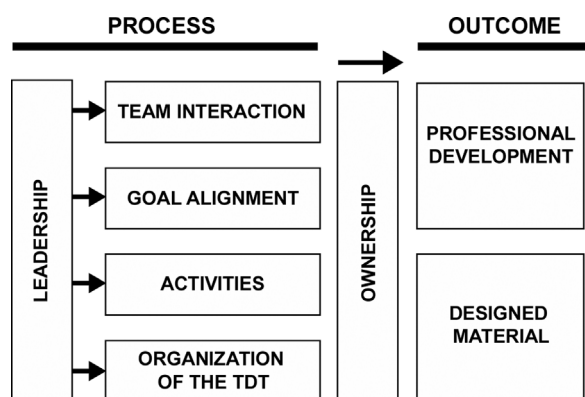


Fig. 1. Descriptive framework for TDTs including process and outcome stage.

1.3. Professional development

As explained in the introduction, teachers' professional development is one of the main objectives for TDTs. Teachers who participate in a TDT can gain new knowledge and skills, such as pedagogical knowledge, content knowledge, design skills or professional skills such as networking (Bakah et al., 2012b; Huizinga et al., 2014; Kafyulilo et al., 2014; Voogt et al., 2011). As Desimone et al.'s (2013) theory of action suggests, students can only benefit from this new knowledge and skills if teachers use them in practice.

To assess the professional development of TDT participants, we use three levels (Desimone et al., 2013; Guskey, 2002; Kirkpatrick, 1996). The first level concerns the teachers' initial **satisfaction** with the TDT. How was their experience of it and were they happy with the TDT? The second level is the teachers' **learning**: did the participants gain new knowledge and skills? The third level is when teachers actually apply these new understandings and skills and **change their behaviour** in the classroom. An example of such application could be when teachers change the way they teach by applying new strategies for instruction.

1.4. Designed material

The second main objective for TDTs is developing educational materials. The type of material the participants develop depends on the focus of the TDT. For example, they can choose to design a complete educational module that takes several weeks to teach, or they can design several smaller instructional units, such as experiments, digital quizzes or tests.

To evaluate the designed material, its **perceived quality** can be assessed. As with the professional development, we also evaluate a further level: the **actual use** of the designed material after it was designed. Here we need to note that schools in the Netherlands are characterized by great autonomy (OECD, 2014): schools and their teachers are highly autonomous on matters regarding curriculum planning and assessment, as compared to other countries. For example, schools and teachers can choose which teaching methods or textbooks they use. Therefore, participants from our TDTs can choose whether they actually use the designed material or not.

1.5. Sense of ownership

Although professional development and the designed materials are the main objectives for TDTs, to reach the higher levels of the outcomes (change of behaviour in classroom and actual use of the material), a sense of ownership is desired. As we explained in the introduction, a sense of ownership of the innovation is likely to develop in TDTs, as teachers are engaged in designing innovative educational material (Bakah et al., 2012a; Cviko, McKenney, & Voogt, 2013; Visser et al., 2012). In this way, the professional development and the designed materials are adapted to teachers' own practice, which increases the chance that teachers will implement the innovations (Wikeley et al., 2005). However, previous research indicated that TDT participants do not always implement innovations in practice (Binkhorst et al., 2015). This implies that designing materials in TDTs might not automatically lead to ownership of the innovation and hence implementation.

Other studies conceptualized ownership as 'ownership of an organization', or 'ownership of a community' (Avey, Avolio, Crossley, & Luthans, 2009; Buchem, 2012; Lee & Suh, 2015). These studies indicate that ownership of a community can lead to positive attitudes and behaviours (Avey et al., 2009; Lee & Suh, 2015). Applying this broader definition of ownership to TDTs might explain why certain participants do change their teaching practice and use the designed material and others do not.

Ownership of the TDT can be defined along four dimensions (Avey et al., 2009). First, **self-efficacy** is a person's belief that he can succeed at a specific task and that he can make a substantial contribution. Second, **accountability** is the feeling that everyone in the team can be

held accountable for their actions and for the eventual results. Third, **belongingness** is defined as the feeling that a place or object (in our case, the TDT) feels like ‘home’. It is the feeling that an individual is attached to, or belongs in the TDT. Finally, **self-identity** is slightly different from belongingness. It occurs when the TDT, or specific targets of the TDT, become classified ‘as an extension of the self’, or in other words, when they become part of the individual’s identity.

1.6. Process features

Studies of TDTs and other (networked) PLCs have shown that a well-designed process including effective interaction, clear goals and relevant activities is essential for achieving the desired outcomes (Binkhorst et al., 2015; Handelzalts, 2009; Stoll et al., 2006). We distinguished four process features that will be addressed: Team interaction, Goal alignment, Activities and Organization.

1.6.1. Team interaction

Team interaction is crucial for teacher teams (Gast, Schildkamp, & van der Veen, 2017), and is considered most effective if there is an open atmosphere of **communication**, in which teachers are willing to share ideas and information with each other (Dickerson, Jarvis, & Levy, 2014; Hoegl & Gemuenden, 2001; Stoll et al., 2006). Furthermore, **mutual support** by giving each other feedback and by openly discussing different views or potential conflicts is a vital aspect of team interaction (Grossman, Wineburg, & Woolworth, 2001; Hord, 2004). Equal **participation and effort** from the team members also promotes the effectiveness of the group’s work, as it strengthens their commitment to the team (Stoll et al., 2006). Furthermore, it is important that the team members feel **coherence** in the group (Gast et al., 2017; Hoegl & Gemuenden, 2001; Stoll et al., 2006).

1.6.2. Goal alignment

Goal alignment is an essential process feature for professional communities such as TDTs (Hord, 2004; Meirink, Imants, Meijer, & Verloop, 2010; Stoll et al., 2006). Studies have indicated that there should be coherence between the individual goals, the team goals and the overall goals of the program (Meirink et al., 2010; Penuel, Fishman, Yamaguchi, & Gallagher, 2007). In other words, it is important that **goals are shared** among team members (Stoll et al., 2006).

Furthermore, **discussing the goals explicitly** is crucial for the outcomes (Binkhorst et al., 2015). Teams that do not discuss their goals explicitly often have varying and even conflicting interpretations and therefore misconceptions of the goals (Johnson et al., 2014). Participants need to engage in collaborative sense-making to understand and work through these misconceptions (Allen & Penuel, 2015).

1.6.3. Activities

Activities the team carries out are the third feature of the process. In our previous study, we identified three categories of activities that could take place in TDTs (Binkhorst et al., 2015). The first type of activities consists of **knowledge-related activities within meetings**. During the meetings, teachers can share information and discuss experiences with each other, but external expertise is also considered to be crucial (Cordingley, Bell, Rundell, & Evans, 2005). External experts present ‘formal knowledge’ and up-to-date developments to the group (Erickson, Minnes Brandes, Mitchell, & Mitchell, 2005).

TDTs can also perform **design-related activities within the meetings**, for example, designing an overall structure for a lesson or writing texts for educational materials. Being involved in the actual design of educational material develops teachers’ professional competencies, as opposed to only involving teachers in the implementation of new educational materials (Shawer, 2010).

Finally, teachers can perform **activities outside of TDT meetings**. Such activities could include searching for relevant articles to discuss in the next meeting, writing parts of the educational material or

implementing (parts of) the educational material in the classroom. Implementation of materials in class between the TDT meetings is particularly important, as professional development programs are most effective if they are coherent with teachers’ own classroom practices (Vescio et al., 2008; van Driel et al., 2012; van Veen et al., 2010).

1.6.4. Organization of the TDT

Furthermore, it is important how TDTs are organized. For example, the duration, the frequency and the location where the meetings take place all can affect the outcomes (Handelzalts, 2009; van Driel et al., 2012; van Veen et al., 2010). In this study, we zoom in on three aspects of organization. First, the method for **planning** the TDT meetings is important. Some teams meet on a regular basis, for example, every second Monday of the month. Other teams have to choose a new date every time they plan a meeting. Studies have shown that it is beneficial for teams to organize meetings on a regular basis (Handelzalts, 2009).

Second, although formally the time investment for our TDTs is 60 h, because some of the activities take place outside the TDT meetings the **actual time investment** varies for each participant. It can be helpful if participants’ schools are supportive, and if they give their teachers designated time and space (Stoll et al., 2006), but teachers themselves also need to make time for the TDT activities outside the meetings.

Third, the **composition** of the group as a whole can vary. Variables such as team size, previous experience as a group or professional backgrounds could all be considered.

1.7. Leadership

Leadership style is crucial in all types of team work, as it can directly influence the work process (Cordingley et al., 2005; Grossman et al., 2001; Scribner, Sawyer, Watson, & Myers, 2007). Although in theory, TDTs are self-regulating teams in which participants have the autonomy to make decisions for the team (Handelzalts, 2009), various studies have emphasized the importance of support from a team coach. The team coach is expected to organize the TDT meetings, to provide basic process-support and to bring in expert knowledge about pedagogy (Becuwe, Tondeur, Pareja Roblin, Thys, & Castelein, 2016; Huizinga et al., 2013; McKenney, Boschman, Pieters, & Voogt, 2016).

There are two main types of leadership: **vertical leadership** and **shared leadership** (Pearce & Sims, 2002; Pearce, 2004). Vertical leadership is the traditional form for leading teams; one person guides his or her followers. Shared leadership occurs when team members show leadership behaviour themselves, for example, by guiding or inspiring fellow team members, or by taking the lead in planning activities. Over recent decades, the overall consensus has become that teams tend to perform better if leadership is shared (Bergman, Rentsch, Small, Davenport, & Bergman, 2012; Hoch, Pearce, & Welzel, 2010; Pearce & Sims, 2002; Scribner et al., 2007). However, some studies have suggested that we should strive for a hybrid form of leadership, incorporating a **mix** of both vertical and shared leadership (Gronn, 2009; Pearce, 2004).

In this study, we examined the extent to which the leadership of TDTs was shared, by exploring both the team coach’s and the team members’ influence on shaping the process. If the team coach mainly steers the process, it can be categorized as vertical leadership and if participants take the lead it can be categorized as shared leadership. We expected that in teams in which the leadership was primarily shared, teachers would experience a strong sense of ownership of the TDT. However, we also expected that some degree of vertical leadership is needed to give the process a clear structure.

1.8. Research questions

In the problem statement, we explained that there is little empirical research available that evaluates how the complete process of TDTs works and how aspects of the process are linked with their perceived outcomes. Therefore, the aim of this study was to obtain in-depth

Table 1
Information about the three cases.

	TDT A	TDT B	TDT C
Focus of the TDT and their products	General theme: digital tools in education. Various sub-goals, e.g.: redesigning a digital lesson series, exploring computer simulations for chemical experiments, digital quizzes	Constructing practical assignments for technical design projects, including assessment tools.	Redesigning a complete 10-week thematic module about a multidisciplinary science topic.
Strategy for formulating the goal	Team responsible for setting the goal	Team responsible for setting the goal	Goal was fixed beforehand
Number of participants	9	6	6 ^a
Number of meetings	9	7	7

^a Two more participants joined TDT C after the start date.

insights into the TDT process through exploration of multiple perspectives in three case studies and to explore possible links with the TDTs' outcomes. The theoretical framework was used to address the following research questions:

- What are the perceived outcomes of TDTs, in terms of professional development, designed material and sense of ownership of the TDT?
- How are the TDTs' processes, in terms of leadership and the four process features, linked with the TDTs' perceived outcomes?

2. Method

A qualitative case study approach was used to find explanations and in-depth insights into the functioning of specific cases (Yin, 2013). We selected three TDT case studies to monitor for a year by collecting qualitative data from multiple perspectives. We observed the TDT meetings, collected logbook entries after each meeting and interviewed both the TDT participants and the team coaches. The ethical committee of our university approved the design of this study.

2.1. Case descriptions

Our university in the Netherlands has been organizing networked TDTs since 2010. The duration of a TDT at our university is always one academic year. After each year, teachers can decide to extend their participation for another year. The TDTs have monthly 3 h meetings at the university.

Most of these TDTs have focused on secondary school science subjects, because science teachers always need to find new ways to teach in stimulating, imaginative and creative ways to develop students' curiosity (Mooney Simmie, 2007). Furthermore, it is considered important for teachers to move beyond textbook science and to introduce students to science currently being worked on in laboratories, as this gives students a more realistic view of what science entails (Kolstø, 2001).

In this study, we monitored three TDTs during the 2014–2015 academic year. We refer to these teams as TDT A, TDT B and TDT C. These specific TDTs were selected because they all had a team coach with experience in leading TDTs since the TDTs started in 2010. The three team coaches all worked as teacher educators at the university's school of education, and they were not involved as researchers or authors of this paper. The team coaches were responsible for recruiting participants from various schools in the region, chairing the meetings and providing expert knowledge about pedagogy and designing educational materials. The team coaches had no prior instructions on *how* to coach the TDTs and they did not receive any specific training. They informally exchanged their TDT-experiences with each other. The first author of this paper observed the meetings, but she was not involved in the organization of the TDTs.

The aim of the three TDTs was to design new educational materials or experiment with new instructional strategies for the teachers' own subjects, but the exact focus of the TDT and the strategy for formulating the goal differed. We will briefly describe the three TDTs.

- **TDT A** did not have a pre-defined goal, but the participants were responsible for setting the goal. Although the TDT did not specifically articulate a team goal, the general theme could be summarized as: digital tools in education. The TDT had nine participants, who had a meeting every month. In these meetings they enacted collaborative activities that were related to the general theme. Both the team coach and the participants initiated these activities. In total, TDT A had nine meetings.
- **TDT B** included six teachers, who set the team goal during the first meetings. The team coach led this process of defining the goals, but the participants all provided input. Their goal was articulated as: constructing practical assignments for technical design projects, including assessment tools. In total, TDT B held seven meetings, in which they worked towards these goals.
- In **TDT C**, the team goal was pre-defined: redesigning a complete 10-week thematic module about a multidisciplinary science topic. This TDT initially had 6 participants, but during the year, two more participants joined the team. The participants of TDT C all had their own specific tasks in the TDT. The team coach played an important role in coordinating this division of tasks. TDT C held 7 meetings in total.

The characteristics of the TDTs are summarized in Table 1.

2.2. Respondents

The TDTs consisted of six to nine teachers from different schools who all taught the same science-related school subject; either Chemistry, Physics or the multidisciplinary subject Nature, Life and Technology (NLT). At the start of the first meeting, two or three participants from each TDT were selected as interview respondents on a voluntary basis. Representativeness of the respondents in terms of age, gender and prior TDT experience was checked with the team coach. Furthermore, the three team coaches also acted as respondents.

2.3. Instruments

The three TDTs were monitored over one academic year. The data collection consisted of three stages, as depicted in Table 2.

The first stage was setting a baseline. After the first meeting, we held semi-structured interviews with the team coaches and the selected participants. The interviews were aimed at uncovering expectations for the process and the outcomes. Each interview took between 20 and 45 min.

During the year, all TDT meetings were audiotaped and if possible, the first author of this paper observed the meetings. However, as some TDTs were held simultaneously, the observer was not able to attend all meetings. After each meeting, both the team coach and the observer completed a logbook entry about the meeting. When the observer missed a meeting, the logbook entry was completed after listening to the audio recording. The logbook addressed explicit open questions about the key elements of the process.

In the final stage, after the last meeting, we again held semi-

Table 2
Schematic overview of the collected data.

Stages in the research		TDT A	TDT B	TDT C
Baseline stage Aim: Insights into expectations about process and outcomes.	Number of interviews with participants (respondents)	3	3	2
Process stage Aim: Detailed insights into process, including process features and leadership style	Number of interviews with coaches	1	1	1
	Number of audio recordings of meetings	9	7	7
	Number of meetings observed by researcher	4	4	6
	Number of logbook entries completed by coaches	9	1	7
	Number of logbook entries completed by researcher	9	7	7
Final stage Aim: Looking back at the process and insights into perceived outcomes	Number of interviews with participants (respondents)	3	3	3
	Number of interviews with coaches	1	1	1

structured interviews with the team coaches and the same respondents from each TDT. During these interviews, the respondents reflected on the process and perceived outcomes. Each interview took between 30 and 60 min.

2.4. Data analysis

All interviews were audiotaped and then transcribed verbatim. The transcripts were coded by labelling text sections, based on all aspects that are shown in bold in the theoretical framework (e.g., professional development: learning). For the sections about leadership, we coded for which part of the process was led (i.e., shaping goal alignment, stimulating team interaction, planning activities, organizing the TDT) and whether the leadership was vertical, shared or mixed. Some examples of codes are shown in Table 3. A PhD student who was not involved in this study independently double-coded 10% of the codes. The inter-rater reliability based on Cohen's kappa was 0.79.

Subsequently, all codes from the interviews were sorted in a table for each case. We summarized the perceptions of each individual respondent per code and we searched for similarities and differences between the individual respondents. This resulted in a summary per code for each case.

The logbook entries completed by the team coaches and observers included explicit questions about the aspects that are shown in bold in the theoretical framework. Therefore, the logbooks were already pre-coded, and could be directly structured in a table similarly to the interview data. Examples of the pre-coded logbook entries are shown in Table 3. Again, we developed a summary per code for each of the three cases.

Next, the three cases were analysed by comparing the logbook summaries and the interview summaries. We mapped the variables from the descriptive framework and searched for links between them by looking for patterns. For example, when found a cluster of respondents that clearly reported a strong sense of ownership of the TDT, we looked how the process factors or outcome factors of this group differed from the other respondents. Furthermore, sometimes respondents indicated links between factors themselves. In these cases, we searched the data

to confirm these perceived links.

3. Results

The descriptive framework, depicted in Fig. 1, is used to describe the functioning of the three cases. We begin with addressing the first research question by presenting the perceived outcomes of the TDTs in terms of professional development, designed material and sense of ownership of the TDT. Then we address the second research question, by describing the features of the process and the leadership style, and their links with the TDTs' perceived outcomes.

3.1. Professional development

In the baseline interviews, the respondents in all TDTs indicated that they hoped to gain new knowledge and skills, but they were not sure what type of new knowledge and skills they could expect. They hoped to “get new ideas from others”, to “become more aware of their own didactic approach”, or to “learn more about designing materials”. Furthermore, most respondents stated that they thought their teaching practice would improve in small steps, mainly by trying new things in the classroom, but they were not sure what type of improvements to expect. The team coach from TDT A explained that although he expected that participants would learn new things, it was difficult to predict exactly what type of new knowledge and skills they will gain when the main focus of the TDT was still undecided: “I expect they will learn new things. But what they learn depends on what will happen. Right now, I'm not able to predict that properly.” This illustrates that teacher professional development is not perceived as a linear rational process, but as a more complex development.

In the final interview, as a first **reaction** the respondents stated that they were fairly satisfied with the TDT. Most of them also indicated that they had **learned**: they gained some new knowledge and skills. In TDTs A and B, the respondents explained they mainly gained new pedagogical insights, by sharing knowledge and experiences with each other. One respondent from TDT B explained: “I gained more insights into how other teachers view education and pedagogy. It's good to learn that from

Table 3
Examples of codes and logbook entries.

Code	Example from interview	Example from logbook
Professional development – learning	“I gained new knowledge and skills about how to use digital tools in the classroom” (Respondent TDT A)	–
Ownership – accountability	“I felt accountable for my specific tasks. For the rest of the TDT as well of course, but I specifically wanted my part to succeed” (Respondent TDT C)	–
Team interaction – mutual support	“We supported each other and we asked each other to provide feedback” (Respondent TDT A)	“The participants who brought an assignment received feedback from the others” (Observer TDT B, meeting 4)
Leadership – shaping goal alignment – mixed	“We mentioned ideas for the team goal and the coach wrote it down. He searched for a central theme in our ideas” (Respondent TDT B)	“I played a central role by leading the discussion about the team goal. I tried to incorporate everyone's ideas and input” (Team coach TDT C, meeting 1)

others”. In TDT C the teachers also indicated that they gained new content knowledge about the topic of the material they worked on. Some teachers reported actual **change in behaviour**, as they perceived their classroom practice to be improved. However, they were not sure whether this improvement was due to the TDT, or due to the fact that they *always* improve incrementally.

3.2. Designed material

In the baseline interviews, respondents from TDT A did not have very clear expectations for the designed material. However, they all hoped and expected to design concrete materials that could be applied in the classroom. In the final interviews, the respondents from TDT A explained that they worked on various **educational materials**; therefore, all respondents mentioned different end products. One respondent redesigned a digital lesson series herself, tested it in practice and shared her experiences during the TDT meetings. She was very satisfied with this end product and she was determined to **use it in the future**. The other two respondents mainly mentioned smaller end products, such as interactive quizzes and working with computer simulation tools. They were less satisfied with the quality; in the final interview they mentioned that the TDT was less productive than they had expected: *“It was a bit chaotic and not productive. We invested our energy in many different things. [...] I think we should and could have achieved more.”* These respondents did not mention clear plans to use the designed material in the future.

In TDT B, the respondents also had no clear expectations for the designed material in the baseline interviews. In the final interviews, the respondents all mentioned an assessment tool for technical design projects as the end product. In general, the respondents were happy with the **quality of this end product** and they all planned to **use it in the future**. However, two respondents mentioned that it was still work in progress and that the tool was not completely finished yet.

The respondents from TDT C had a clear view of what to expect beforehand and what the module should look like by the end of the year. In the final interviews the three respondents and team coach indicated that they were satisfied with the **quality of the module** they designed; however, it was not yet finished at the end of the year. The team coach explained during the interview that they worked on many separate facets, and it still had to be brought together into a single module: *“We mainly developed some new experiments. [...] But we still have to bundle it into one module and make a guideline for [other] teachers with tips and tricks on how to use this module.”* All respondents mentioned that they **planned to use** at least some parts of the module in their classroom practice, but only one respondent mentioned plans to use the complete module.

3.3. Sense of ownership

In each TDT, there were respondents who had a strong sense of ownership of the TDT, and respondents who felt less ownership. We did not find differences regarding sense of ownership between the teams in general.

Four of the nine TDT respondents who were interviewed after the TDT mentioned **self-efficacy** regarding ownership of the TDT. They believed they had made substantial contributions to the team and the product. The other respondents felt less certain about their ability to make a substantial contribution. They mentioned different reasons, for example: *“When I tried to work with it, I encountered many technical problems, so I couldn’t move forward to the pedagogy of the material”* (Respondent TDT A) or *“From the start, I was a bit unsure about the process... What is the division of roles, what can I contribute?”* (Respondent TDT C).

Three respondents (one from each TDT) felt that they could be held **accountable** for the work in the TDT. Four respondents only felt accountable for their own tasks that they initiated themselves, not for the

TDT as a whole. The other two respondents did not feel any accountability. One of them explained: *“I think we could have achieved more in the TDT but I don’t blame myself for that. I think I didn’t feel enough engaged in the TDT”* (Respondent TDT A).

All respondents felt **belongingness** with the team. They explained that it felt good to be a part of a team, and that it was a relief compared to other programs for professional development.

Furthermore, all respondents mentioned that the TDT had become part of their **identity** as a teacher to some extent. They argued that what they did in the TDT – collaboration with colleagues and working on educational innovations – are also important aspects of being a teacher. They explained that doing these actions, rather than the TDT itself, felt like part of their identity.

There were three respondents (one from each TDT) who felt a strong sense of ownership of the TDT, on all four dimensions. These three respondents were also positive about their professional development and the designed material. In particular, they mentioned the most plans to use the designed materials and the new knowledge in practice. The converse was also true: the three respondents with the least sense of ownership of the TDT were less satisfied with the professional development and designed material. This illustrates how sense of ownership may well be linked with perceived outcomes in terms of professional development and designed material and is a hypothesis worthy of further research and consideration.

3.4. Process features

3.4.1. Team interaction

The team coaches from all TDTs mentioned in their logbooks that the team discussed actively and openly. The interview respondents reported the same impression regarding the team’s **communication**. However, one respondent from TDT C mentioned some struggle related to communication, as every participant worked on isolated tasks. This was also mentioned in the observer’s logbook about TDT C: *“The participants all work on their own tasks, the communication mainly goes through the team coach.”*

The interview respondents and the logbooks indicated that the participants in TDTs A and B **supported** each other. They tried to help each other and gave each other feedback. The interview respondents from TDT C mentioned it was difficult to support each other, because everyone had their own specific tasks.

The interview respondents from TDT A mentioned that the **participation and effort** from the individual team members was perceived to be equally distributed, although not every participant was equally active for the different topics. In TDTs B and C some participants did more than others.

The respondents from TDTs A and B indicated there was clear **coherence** in the group. A respondent in TDT B explained: *“We are all teachers from the same subject striving for the same passion, yes, I definitely felt coherence.”* In TDT C, the respondents said it did not really feel like a team. The team coach explained in the final interview that every participant had his or her own specific tasks and that he was the connecting factor as a team coach.

All respondents and the team coaches indicated that good team interaction is important for the TDTs’ outcomes. The respondents from TDTs A and B were positive about their team interaction, and they explained that the team’s outcomes in terms of professional development and designed material benefited from their effective team interaction. In TDT C, the respondents were less positive about the team’s interaction. They explained that the outcomes could have benefited from better team interaction.

3.4.2. Goal alignment

As indicated in Table 1, there were different strategies for formulating a team goal: in TDTs A and B, the team was responsible for setting the goal, and in TDT C, the goal was fixed beforehand.

The observer's logbook indicated that TDT A did not **explicitly discuss the team goal** in any meeting. In the first meetings, they talked about possible activities, but they did not formulate a goal. The interview respondents from TDT A also stated that they did not discuss the team goal explicitly. In TDT B, both the team coach's and the observer's logbooks indicated that the team explicitly discussed the team goal during the meetings. In TDT C, the goal was fixed beforehand, and the team discussed the requirements during the first meeting. During the final two meetings they returned to these requirements, but the goal was not discussed explicitly in between, according to the logbooks.

The interview respondents from TDT A indicated that they did not have one **shared goal**, but they had various smaller goals. One respondent explained that a shared goal was lacking: *"I missed some structure and an explicit goal that everyone supports. Some clearness about what we are actually going to do together."* In TDTs B and C, all respondents indicated there was a shared goal. However, the team coach from TDT C explained that there were differences in interpretations of the goal: *"We had a shared goal, but the interpretations of the goal, and in particular the views of what we had to do to reach that goal varied"*.

Overall, we found a link between goal alignment and perceived outcomes. Seven out of nine teachers explicitly mentioned in the final interviews that clear goals and corresponding activities are essential to provide focus in the designed material. Some of them felt that these features were missing, as a respondent from TDT A explained: *"We did many small things, and a bigger product is not completed. A bit more to the point; that would be an idea [to promote the TDT's outcomes] I think."*

3.4.3. Activities

The observer's and team coach's logbooks indicated that all teams spent the most time on **knowledge-related activities during** the meetings. Such activities included: discussions about pedagogical strategies, discussions about the use of digital tools, sharing experiences from the classroom and sometimes lectures from external experts.

The three TDTs also did some **design-related activities** during the meetings. These included: developing an online inquiry learning space for a computer simulation (TDT A), constructing an assessment tool together (TDT B) or editing a draft version of a module (TDT C). In the baseline interviews, most respondents indicated that they expected that the focus would be on these design-related activities rather than knowledge-related activities.

The **activities outside of the TDT meetings** varied from person to person. In TDTs A and B, some participants tested the designed material in the classroom, while others did not. This enactment was always discussed and evaluated with the other participants in the next meeting of the TDT. Respondents who did implement the materials in practice during the design process explained that this was valuable for the TDTs' progress and the outcomes. In TDT C every participant had his or her own specific tasks to perform outside of the TDT meetings. However, the team coach mentioned in the logbook that the objective of these activities was not always achieved: *"Apparently the task [developing description of a practical exercise] was not clear. They just provided small pieces of text, not a complete document."*

Respondents from all TDTs indicated that the practical activities, such as writing, producing or brainstorming were most valuable for the TDT's outcomes. In particular, testing (parts of) the designed material in practice was seen as an essential activity for bringing the designed material to a higher level.

3.4.4. Organization of the TDT

In the final interviews, all respondents explained that they were positive about the organization of the TDTs. The respondents appreciated that the TDT were networked, as they had the chance to become acquainted with teachers from other schools. Furthermore, the respondents were positive about the interval of one month between the meetings.

TDT A and TDT B **planned** the meetings on a regular basis: every

second Monday of the month. The team coach from TDT C planned each meeting separately. This resulted in more cancellations from participants.

The **time investment** varied from person to person. All respondents knew that they had signed up for a 60 h professional development program, but most respondents spent less time than that.

In TDT C, the respondents perceived some inconsistencies in the team **composition**. During the year, two more teachers joined the TDT, and some experts on the topic joined the meetings now and then. This inconsistency in team composition led to some confusion among team members.

Overall, the respondents and team coaches from TDTs A and B were satisfied with the existing organizational structure. In TDT C, the respondents indicated that the outcomes would have benefited if the meetings were planned on a regular basis and if the team composition had been fixed.

3.5. Leadership

In this section we describe how vertical, shared and mixed leadership behaviours were enacted, with respect to the four features of the process: team interaction, goal alignment, activities and organization.

3.5.1. Stimulating team interaction

For all TDTs, most respondents provided examples of how they stimulated team interaction themselves. For example, a respondent from TDT A stated: *"The team coach didn't have to stimulate our team interaction. Mainly because many ideas came from the participants themselves."* This can be categorized as **shared leadership**. However, the logbooks also indicated a few examples in which the team coaches played a **vertical leadership** role by leading discussions in the right direction, or by making sure that every member had his or her turn in the discussion. In TDT C, where the team interaction was perceived as less effective, the team coach often felt that he had to enact vertical leadership to stimulate and motivate his participants: *"Often I had the feeling I had to motivate and coach all members individually to get something done"*.

3.5.2. Shaping goal alignment

As mentioned above, TDT A did not explicitly discuss a team goal. The team spontaneously planned the activities they came up with. This strategy evoked **shared leadership** behaviour, as many participants pitched their ideas. However, the respondents explained that this also led to some confusion about the mission of the TDT: *"I think it would be better to check what everybody wants to achieve by the end of the year. [...] It should be clear what we are aiming for. Then we are more motivated to actually do something."*

In TDT B, the team coach asked all members to pitch ideas for the end goal during the first meeting. Subsequently, the team voted democratically to choose one of the goals. The respondents appreciated the fact that the team coach took the lead in this process. At the same time, there was room for their own input. This leadership behaviour can be categorized as a **mix between vertical and shared leadership**.

In TDT C, the goal was fixed beforehand. The team coach explained that it was difficult to find the right balance between **vertical and shared leadership** in clarifying this team goal: *"If I would have put all my energy into clarifying the goals, then I'm only describing my own expectations. Instead of describing the needs from the entire team."*

Respondents perceived that a mix between vertical and shared leadership is most effective in shaping goal alignment. Shared leadership was considered crucial to adjust the goals to participants' own needs. At the same time, vertical leadership could create clarity, which is needed to actually achieve something.

3.5.3. Planning activities

In TDTs A and B, both the team coach and the participants took the

initiative for activities. However, the perceived degree of **shared leadership** differed from person to person. This is illustrated by these two quotations from respondents in TDT B: “*We can decide everything; if you want to turn left, we turn left. The team is free in that sense, we can initiate all activities*” versus “*Our coach chose the activities. He came with ideas and possible approaches.*”

In TDT C, both the team coach’s and observer’s logbooks indicated that the team coach initiated most activities. The team coach and each respondent agreed upon the specific tasks and the coach kept an overview of what activities were needed to reach the team goal. This method for planning the activities could be categorized as **vertical leadership**. In the final interviews, two of the three respondents from TDT C described similar examples of vertical leadership regarding planning the activities. However, one of the respondents explained that she could initiate, plan and enact all activities that she wanted, which can be considered **shared leadership** behaviour.

Both team coaches from TDTs A and B explicitly explained that shared leadership in planning activities was important for the team’s outcomes. TDT B’s coach explained: “*I appreciate initiative. If someone comes up with something and wants to share it. Then you get feedback from others and you can bring it to a higher level.*” Respondents from all TDTs agreed that shared leadership regarding planning activities was important. Overall, the respondents who perceived the leadership regarding planning the activities to be shared had a stronger sense of ownership of the TDT. However, respondents also explained that it was not desirable to have only shared leadership. One respondent from TDT A explained that too many initiatives could lead to reduced quality of the activities: “*Some activities just came by and had nothing to do with our goals. This resulted in reduced quality, and activities were not always well aligned.*” Respondents explained that more vertical leadership could have ensured that the activities corresponded with the team goals. For example, the team coach could have stimulated them to test (parts of) the designed material in practice, and to reflect on this enactment within the meetings.

3.5.4. Organizing the TDT

In all TDTs, the team coaches organized the meetings. The team coaches set the dates for the meetings, arranged the rooms to meet in and sent the participants an invitation for each meeting. These managerial tasks can be categorized as **vertical leadership**.

4. Discussion

In this study, we aimed to obtain a deeper understanding of the process features and leadership styles in TDTs and their possible links with the TDTs’ perceived outcomes. We studied three cases of TDTs, addressing the following research questions: What were the perceived outcomes of the TDTs? How was the TDTs’ process linked with the perceived outcomes? In this section we will discuss our main findings and the implications for future TDTs.

4.1. What were the perceived outcomes of the TDTs?

All respondents indicated that they gained new insights and learned some new things, which is in line with previous research about TDTs (Bakah et al., 2012b; Huizinga et al., 2014; Voogt et al., 2011). However, teachers found it difficult to indicate whether these learning gains would lead to improved classroom practice.

The three TDTs all designed educational materials. These materials were seen as useful, and some respondents were determined to use them in the future. However, most respondents indicated that they had higher expectations about the end product beforehand. Furthermore, in some cases the designed material was not yet finished. Therefore, some teachers found it difficult to predict whether they would use it in the future. As with other research, these findings about the perceived outcomes suggest that one year of participation in a TDT might not be

enough to realize professional growth, to design materials and to implement them in practice (Houtveen & van de Grift, 2012).

According to the literature, engaging teachers in the process of designing innovative educational material could lead to a sense of ownership of the innovation (Cviko et al., 2013; Voogt et al., 2015). In this study, we broadened this concept to ‘ownership of the TDT’. All respondents felt ownership related to the TDT in terms of belongingness and self-identity. However, only some of the respondents felt a sense of ownership in terms of self-efficacy and accountability. Therefore we can state that engaging teachers in designing educational materials does not automatically lead to a sense of ownership of the TDT.

Furthermore, we found a tentative link between sense of ownership of the TDT and the outcomes of the TDT: respondents who expressed a strong sense of ownership of the TDT tended to actually use the designed material in practice and to change their classroom practice. This is in line with literature that states that ownership of an innovation can contribute to sustainable implementation of educational innovations (Carlgren, 1999; Mooney Simmie, 2007).

To summarize, although the main objectives for TDTs were achieved to some extent, not all respondents had yet achieved the higher levels of the outcomes (change of behaviour in classroom and actual use of the material). The perceived outcomes of the TDTs differed not from case to case, but from person to person.

4.2. How was the TDTs’ process linked with the perceived outcomes?

In the results section, we described the process features (i.e., team interaction, goal alignment, activities and organization of the TDT) and the leadership styles in the TDTs in detail. We found several links between these processes and the perceived outcomes of TDTs.

All teachers and the team coaches indicated that team interaction was essential for the TDTs’ outcomes, which is in line with other research (Dickerson et al., 2014; Gast et al., 2017). In general, the participants communicated openly and they supported each other. Respondents and team coaches indicated various examples of shared leadership regarding team interaction. They all explained that shared leadership regarding team interaction was desirable, as this can stimulate openness and better feedback. However, in TDT C – in which the team interaction was perceived as less effective – the team coach felt he had to enact vertical leadership to motivate and coach every participant individually.

We also found a possible link between the goal alignment and the perceived outcomes of the TDT. Respondents who indicated that the goals were shared and discussed explicitly were also more positive about the TDT’s outcomes. The approach regarding the team goal differed for each TDT. In TDT A, there was a high level of shared leadership regarding goal alignment, as participants could pitch their ideas. However, they never explicitly discussed the team goal, which led to a lack of clarity about the team goal. In TDT B, there was also shared leadership regarding goal alignment, as participants could pitch their ideas. But in TDT B this was combined with vertical leadership, as the team coach led the process of choosing a goal and ensured that the team chose a focus. They discussed the team goal regularly and all respondents felt the goal was shared. In TDT C, the goal was fixed beforehand and was perceived as shared. However, the exact requirements for the end product were not clear to all members, as they did not often explicitly discuss the team goal. Based on our findings, we cannot state which strategy for formulating a team goal is best. However, we can conclude that pitching ideas for the team goal can ensure that the goals are aligned with participants’ own needs, and that explicitly discussing the team goal can improve clarity. This was also demonstrated in other studies (Allen & Penuel, 2015; Johnson et al., 2014). Therefore, a mix between shared and vertical leadership regarding goal alignment appears to be needed to promote the outcomes of the TDT.

The practical design-related activities, such as writing, constructing and designing were considered the most valuable activities for the

TDT's outcomes. However, all TDTs mainly performed knowledge-related activities during the meetings. Not all respondents carried out activities outside of the TDT meetings. The respondents who tested the designed materials in practice stated that such testing is essential to the success of a TDT, which was also found in other studies about TDTs (Coenders, Terlouw, Dijkstra, & Pieters, 2010; Cviko et al., 2013). In TDTs A and B, both team members and the team coach initiated and planned activities. In TDT C, the team coach mainly took the lead in planning activities. The perceived degree of shared leadership regarding planning the activities varied from person to person, rather than from team to team. Respondents who mentioned the most examples of shared leadership had a stronger sense of ownership of the TDT, and were more positive about the outcomes of the TDT. This finding is in line with literature that suggests that motivating leadership behaviours enhance the sense of ownership (Avey et al., 2009). However, respondents also explained that vertical leadership was needed to ensure that the activities corresponded with the TDT's goals and to stimulate participants to carry out activities outside the meetings, as this could improve the quality of the designed material.

The organization of TDT A and B was perceived as efficient. Both the team coach and the team members of TDT C mentioned that it would have been better to have meetings on a regular basis, as the other teams did.

To summarize, we found that the process of TDTs is largely shaped by the leadership style. Shared leadership can ensure that the formulated goals of the TDT and activities during the process are adapted to participants' own needs, which can strengthen the sense of ownership of the TDT and hence promote the outcomes of the TDT. Furthermore, the respondents also indicated that vertical leadership was needed to provide structure and clarity in the process, which is essential for actually achieving something. Therefore, we conclude that a hybrid form of leadership, with a mix of both shared and vertical leadership (Binci, Cerruti, & Braganza, 2016; Ensley, Hmieleski, & Pearce, 2006; Gronn, 2009; Pearce, 2004) appears to be most effective for TDTs.

4.3. Implications: directions for future TDTs

This study provided in-depth insights into the outcomes of TDTs and how the process is linked with these outcomes. These insights can be useful for teacher educators who are planning to establish TDTs or other types of (networked) PLCs, or who want to improve the outcomes of existing teacher teams.

We showed that leadership plays a vital role in shaping the process of the TDTs and hence their outcomes. To improve the outcomes of future TDTs, shared leadership is essential. Participants need to feel that they can take the initiative themselves to shape and lead the program in order to enhance the sense of ownership of the TDT and hence improve the likelihood that high quality materials will be designed and incorporated into teachers' practice. However, we found that the perceived degree of shared leadership varied from person to person, as not all participants felt they could take the initiative. Therefore, in future TDTs it is important that team coaches clearly explain that shared leadership is expected, to ensure that all participants feel that the leadership is to some degree in their hands.

At the same time, this study showed that team coaches play an important role in providing clarity and focus during the process. They need to ensure that clear goals are formulated and that the participants carry out the corresponding activities. Therefore, clear vertical leadership is also needed.

However, how to provide a mix of vertical and shared leadership is not self-evident, and is sometimes even described as paradoxical (Binci et al., 2016; Elloy, 2006; Meirink et al., 2010). There is no literature yet on how team coaches can effectively combine these seemingly contradictory tasks in TDTs or other (networked) PLCs. Therefore, more research is needed to design a new approach that supports team coaches of teacher communities in balancing vertical and shared leadership in

an effective way, to support the process and hence the outcomes. One possible way in which vertical and shared leadership could be balanced is when teacher teams work with a fixed stepwise method that explicitly incorporates time for collaborative brainstorming.

4.4. Limitations and future research

We chose an in-depth qualitative research design that deepened our understandings about how TDTs work in practice. We used a theoretical framework that was developed in a previous study (Binkhorst et al., 2015). This framework was based on theory about TDTs and other types of professional learning communities and was evaluated in practice in the same context of TDTs as the present study. Therefore, this existing theoretical framework was a valuable starting point for this study. Although the generalizability of our findings is limited, in-depth understandings could be relevant for teacher teams in various contexts. As a next step, more research in different settings is needed to obtain a broader understanding of the links between process and outcomes in teacher teams. Furthermore, a limiting factor in this study is that the research is mainly based on self-perceptions of a selection of the participants. However, we used various sources of evidence in terms of data and methods (i.e., interviews, observations, logbooks), to reduce bias (Poortman and Schildkamp, 2011). Furthermore, the representativeness of the selected respondents was checked with the team coach.

Furthermore, a limitation of the study could be that concepts such as ownership of the TDT were only measured by the end of the TDT. Future research could investigate how the sense of ownership develops over time.

To conclude, as stated above, more research is needed to see whether the directions suggested by the present study actually lead to better outcomes of future TDTs. Therefore, we need to design a new approach to organizing and leading TDTs that incorporates aspects of both shared and vertical leadership. This new approach could then be implemented and evaluated to see whether it leads to improved performance.

Acknowledgement

This article is part of the project 'A theoretical and practical basis for Teacher Design Teams' funded and supported by Centre of Expertise TechYourFuture.

References

- Allen, C. D., & Penuel, W. R. (2015). Studying teachers' sense making to investigate teachers responses to professional development focused on new standards. *Journal of Teacher Education*, 66(2), 136–149. <http://dx.doi.org/10.1177/0022487114560646>.
- Avalos, B. (2011). Teacher professional development in Teaching and Teacher Education over ten years. *Teaching and Teacher Education*, 27(1), 10–20. <http://dx.doi.org/10.1016/j.tate.2010.08.007>.
- Avey, J. B., Avolio, B. J., Crossley, C. D., & Luthans, F. (2009). Psychological ownership: Theoretical extensions, measurement and relation to work outcomes. *Journal of Organizational Behavior*, 30(2), 173–191. <http://dx.doi.org/10.1002/job.583>.
- Bakah, M. A. B., Voogt, J. M., & Pieters, J. M. (2012a). Advancing perspectives of sustainability and large-scale implementation of design teams in Ghana's polytechnics: Issues and opportunities. *International Journal of Educational Development*, 32(6), 787–796. <http://dx.doi.org/10.1016/j.ijedudev.2011.11.002>.
- Bakah, M. A. B., Voogt, J. M., & Pieters, J. M. (2012b). Updating polytechnic teachers' knowledge and skills through teacher design teams in Ghana. *Professional Development in Education*, 38(1), 7–24. <http://dx.doi.org/10.1080/19415257.2011.576265>.
- Becuwe, H., Tondeur, J., Pareja Roblin, N., Thys, J., & Castelein, E. (2016). Teacher design teams as a strategy for professional development: The role of the facilitator. *Educational Research and Evaluation*, 22(3–4), 141–154.
- Bergman, J. Z., Rentsch, J. R., Small, E. E., Davenport, S. W., & Bergman, S. M. (2012). The shared leadership process in decision-making teams. *The Journal of Social Psychology*, 152(1), 17–42. <http://dx.doi.org/10.1080/00224545.2010.538763>.
- Binci, D., Cerruti, C., & Braganza, A. (2016). Do vertical and shared leadership need each other in change management? *Leadership & Organization Development Journal*, 37(5), 558–578. <http://dx.doi.org/10.1108/LODJ-08-2014-0166>.
- Binkhorst, F., Handelzalts, A., Poortman, C. L., & van Joolingen, W. R. (2015). Understanding teacher design teams: A mixed methods approach to developing a descriptive framework. *Teaching and Teacher Education*, 51, 213–224. <http://dx.doi.org/10.1016/j.tate.2015.08.007>.

- org/10.1016/j.tate.2015.07.006.
- Boschman, F., McKenney, S., & Voogt, J. (2015). Exploring teachers' use of TPAC in design talk: The collaborative design of technology-rich early literacy activities. *Computers & Education*, 82(c), 250–262. <http://dx.doi.org/10.1016/j.compedu.2014.11.010>.
- Bryk, A. S., Gomez, L. M., & Grunow, A. (2011). Getting ideas into action: Building networked improvement communities in education. In M. T. Hallinan (Ed.), *Frontiers in Sociology of Education* (pp. 127–162). Dordrecht: Springer Netherlands. http://dx.doi.org/10.1007/978-94-007-1576-9_7.
- Buchem, I. (2012). *Psychological Ownership and Personal Learning Environments: Do sense of ownership and control really matter?* Presented at the PLE Conference.
- Carlgrén, I. (1999). Professionalism and teachers as designers. *Journal of Curriculum Studies*, 31(1), 43–56. <http://dx.doi.org/10.1080/002202799183287>.
- Chapman, C. (2014). *From within- to between- and beyond-school improvement: A case of rethinking roles and relationships?*
- Coenders, F. G. M., Terlouw, C., Dijkstra, S., & Pieters, J. M. (2010). The effects of the design and development of a chemistry curriculum reform on teachers' professional growth: A case study. *Journal of Science Teacher Education*, 21, 535–557. <http://dx.doi.org/10.1007/s10972-010-9194-z>.
- Cordingley, P., Bell, M., Rundell, B., & Evans, D. (2005). *The impact of collaborative continuing professional development (CPD) on classroom teaching and learning. Research evidence in education library*. London: EPPI-Center, Social Science Research Unit, Institute of Education, University of London.
- Crow, G. M., & Pounder, D. G. (2000). Interdisciplinary teacher teams: Context, design, and process. *Educational Administration Quarterly*, 36(2), 216–254. <http://dx.doi.org/10.1177/0013161x00362004>.
- Cviko, A., McKenney, S., & Voogt, J. (2013). The teacher as re-designer of technology integrated activities for an early literacy curriculum. *Journal of Educational Computing Research*, 48(4), 447–468. <http://dx.doi.org/10.2190/EC.48.4.c>.
- Desimone, L. M., Smith, T. M., & Phillips, K. P. (2013). Linking student achievement growth to professional development participation and changes in instruction: A longitudinal study elementary students and teachers in title I schools. *Teachers and Teaching*, 115(5), 1–46.
- Dickerson, C., Jarvis, J., & Levy, R. (2014). Learning through projects: Identifying opportunities for individual professional learning and development. *Professional Development in Education*, 40(1), 17–35. <http://dx.doi.org/10.1080/19415257.2013.794747>.
- Elloy, D. F. (2006). Superleader behaviors and self-managed work teams: Perceptions of supervisory behaviors, satisfaction with growth, and team functions. *Journal of Business & Economics Research*, 4(12), 97–102.
- Ensley, M. D., Hmieleski, K. M., & Pearce, C. L. (2006). The importance of vertical and shared leadership within new venture top management teams: Implications for the performance of startups. *The Leadership Quarterly*, 17(3), 217–231. <http://dx.doi.org/10.1016/j.leaqua.2006.02.002>.
- Erickson, G., Minnes Brandes, G., Mitchell, I., & Mitchell, J. (2005). Collaborative teacher learning: Findings from two professional development projects. *Teaching and Teacher Education*, 21(7), 787–798. <http://dx.doi.org/10.1016/j.tate.2005.05.018>.
- Gast, I., Schildkamp, K., & van der Veen, J. T. (2017). Team-Based professional development interventions in higher education: A systematic review. *Review of Educational Research*. <http://dx.doi.org/10.3102/0034654317704306>.
- Gronn, P. (2009). From distributed to hybrid leadership in practice. In A. Harris (Vol. Ed.), *Distributed Leadership: 7* Springer <http://dx.doi.org/10.1007/978-1-4020-9737-9>.
- Grossman, P., Wineburg, S., & Woolworth, S. (2001). Toward a theory of teacher community. *The Teachers College Record*, 103(6), 942–1012.
- Guskey, T. (2002). Does it make a difference? *Educational Leadership*, 59(6), 45–51.
- Handelzalts, A. (2009). *Collaborative curriculum development in teacher design teams*. University of Twente.
- Hardré, P. L., Ling, C., Shehab, R. L., Nanny, M. A., Nollert, M. U., Refai, H., et al. (2013). Teachers in an interdisciplinary learning community: Engaging, integrating, and strengthening K-12 education. *Journal of Teacher Education*, 64(5), 409–425. <http://dx.doi.org/10.1177/0022487113496640>.
- Hoch, J. E., Pearce, C. L., & Welzel, L. (2010). Is the most effective team leadership shared? *Journal of Personnel Psychology*, 9(3), 105–116. <http://dx.doi.org/10.1027/1866-5888/a000020>.
- Hoegl, M., & Gemuenden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. *Organization Science*, 12(4), 435–449.
- Hofman, R. H., & Dijkstra, B. J. (2010). Effective teacher professionalization in networks? *Teaching and Teacher Education*, 26(4), 1031–1040. <http://dx.doi.org/10.1016/j.tate.2009.10.046>.
- Hord, S. M. (2004). *Learning together, leading together*. New York: Teachers College Press.
- Houtveen, T., & van de Grift, W. (2012). Improving reading achievements of struggling learners. *School Effectiveness and School Improvement*, 23(1), 71–93.
- Huizinga, T., Handelzalts, A., Nieveen, N., & Voogt, J. M. (2013). Teacher involvement in curriculum design: Need for support to enhance teachers' design expertise. *Journal of Curriculum Studies*, 46(1), 33–57. <http://dx.doi.org/10.1080/00220272.2013.834077>.
- Huizinga, T., Handelzalts, A., Nieveen, N., & Voogt, J. (2014). Fostering teachers' design expertise in teacher design teams: Conducive design and support activities. *Curriculum Journal*, 26(1), 137–163. <http://dx.doi.org/10.1080/09585176.2014.990395>.
- Johnson, R., Severance, S., Leary, H., Miller, S., et al. (2014). Mathematical tasks as boundary objects in design-based implementation research. In J. L. Polman, E. A. Kyza, D. K. O'Neill, I. Tabak, W. R. Penuel, & A. S. Jurow (Vol. Eds.), *Learning and becoming in practice: The international conference of the learning sciences (ICLS): vol. 2*, (pp. 1127–1131).
- Kafyulilo, A., Fisser, P., & Voogt, J. (2014). Teacher design in teams as a professional development arrangement for developing technology integration knowledge and skills of science teachers in Tanzania. *Education and Information Technologies*, 21(2), 301–318. <http://dx.doi.org/10.1007/s10639-014-9321-0>.
- Kirkpatrick, D. (1996). Great ideas revisited. Techniques for evaluating training programs. Revisiting Kirkpatrick's four-level model. *Training & Development*, 50(1), 54–59.
- Kolsto, S. D. (2001). Scientific literacy for citizenship: Tools for dealing with the science dimension of controversial socioscientific issues. *Science Education*, 85(3), 291–310. <http://dx.doi.org/10.1002/sce.1011>.
- Lee, J., & Suh, A. (2015). How do virtual community members develop psychological ownership and what are the effects of psychological ownership in virtual communities? *Computers in Human Behavior*, 45(C), 382–391. <http://dx.doi.org/10.1016/j.chb.2014.12.002>.
- McKenney, S., Boschman, F., Pieters, J., & Voogt, J. (2016). Collaborative design of technology-enhanced learning: What can we learn from teacher talk? *TechTrends*, 60, 385–391. <http://dx.doi.org/10.1007/s11528-016-0078-8>.
- Meirink, J. A., Imants, J., Meijer, P. C., & Verloop, N. (2010). Teacher learning and collaboration in innovative teams. *Cambridge Journal of Education*, 40(2), 161–181. <http://dx.doi.org/10.1080/0305764X.2010.481256>.
- Mooney Simmie, G. (2007). Teacher Design Teams (TDTs)—Building capacity for innovation, learning and curriculum implementation in the continuing professional development of in-career teachers. *Irish Educational Studies*, 26(2), 163–176. <http://dx.doi.org/10.1080/03323310701295914>.
- OECD (2014). *Education policy outlook*. Netherlands: OECD.
- Pearce, C. L., & Sims, H. P. J. (2002). Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational, and empowering leader behaviors. *Group Dynamics: Theory, Research, and Practice*, 6(2), 172–197. <http://dx.doi.org/10.1037/1089-2699.6.2.172>.
- Pearce, C. L. (2004). The future of leadership: Combining vertical and shared leadership to transform knowledge work. *Academy of Management Executive*, 18(1), 47–57.
- Penuel, W. R., Fishman, B. J., Yamaguchi, R., & Gallagher, L. P. (2007). What makes professional development effective? strategies that foster curriculum implementation. *American Educational Research Journal*, 44(4), 921–958. <http://dx.doi.org/10.3102/0002831207308221>.
- Poortman, C. L., & Schildkamp, K. (2011). Alternative quality standards in qualitative research? *Quality & Quantity*, 46(6), 1727–1751. <http://dx.doi.org/10.1007/s11135-011-9555-5>.
- Scribner, J. P., Sawyer, R. K., Watson, S. T., & Myers, V. L. (2007). Teacher teams and distributed leadership: A study of group discourse and collaboration. *Educational Administration Quarterly*, 43(1), 67–100. <http://dx.doi.org/10.1177/0013161x06293631>.
- Shawer, S. (2010). Classroom-level teacher professional development and satisfaction: Teachers learn in the context of classroom-level curriculum development. *Professional Development in Education*, 36(4), 597–620. <http://dx.doi.org/10.1080/19415257.2010.489802>.
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change*, 7(4), 221–258. <http://dx.doi.org/10.1007/s10833-006-0001-8>.
- van Driel, J. H., Meirink, J. A., van Veen, K., & Zwart, R. C. (2012). Current trends and missing links in studies on teacher professional development in science education: A review of design features and quality of research. *Studies in Science Education*, 48(2), 129–160. <http://dx.doi.org/10.1080/03057267.2012.738020>.
- van Veen, K., Zwart, R. C., Meirink, J. A., & Verloop, N. (2010). *Professionele Ontwikkeling van leraren*. ICLON: Leiden.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, 24(1), 80–91. <http://dx.doi.org/10.1016/j.tate.2007.01.004>.
- Visser, T. C., Coenders, F. G. M., Terlouw, C., & Pieters, J. M. (2012). Design of a model for a professional development programme for a multidisciplinary science subject in the Netherlands. *Professional Development in Education*, 38(4), 679–682. <http://dx.doi.org/10.1080/19415257.2012.669393>.
- Voogt, J., Westbroek, H., Handelzalts, A., Walraven, A., McKenney, S., Pieters, J. M., et al. (2011). Teacher learning in collaborative curriculum design. *Teaching and Teacher Education*, 27(8), 1235–1244. <http://dx.doi.org/10.1016/j.tate.2011.07.003>.
- Voogt, J., Laferrière, T., Breuleux, A., Itow, R. C., Hickey, D. T., & McKenney, S. (2015). Collaborative design as a form of professional development. *Instructional Science*, 43(2), 259–282. <http://dx.doi.org/10.1007/s11251-014-9340-7>.
- Wikeley, F., Stoll, L., Murillo, J., & De Jong, R. (2005). Evaluating effective school improvement: Case studies of programmes in eight European countries and their contribution to the effective school improvement model. *School Effectiveness and School Improvement*, 16(4), 387–405. <http://dx.doi.org/10.1080/09243450500234617>.
- Yin, R. K. (2013). *Case study research - Design and methods* (5th ed.). Sage Publications Inc.