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Teacher collaboration in curriculum design teams: effects, mechanisms, and conditions

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ABSTRACT

Collaborative design positively affects both professional development and the implementation of curriculum change, because teachers develop competencies and practice and develop ownership of the change. The current study was aimed to explore what empirical evidence is available about processes that take place when teachers co-design and how these contribute to professional development and curriculum change. Evidence from 14 PhD studies was collected to study their impact on teacher learning and curriculum change, by analysing effects, mechanisms, and conditions. Results showed that effects of curriculum design teams, in terms of learning outcomes for teachers in areas such as (pedagogical) content knowledge and design knowledge and skills, became manifest in the outcomes of the curriculum design process, and in the appreciation by the stakeholders. We concluded that professional development, through collaborative design in teams, which is specific and linked to the curriculum, influences teachers' knowledge and practice and impacts implementation of curriculum change.

KEYWORDS

Curriculum design;
collaborative design;
professional development;
teacher design teams

Introduction

Teachers' professional development is generally seen as supporting curriculum change, through influencing teacher's competencies and practice (Garet, Porter, Desimone, Birman, & Yoon, 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007). These studies show that promoting curriculum change via teachers can be best achieved through utilizing teacher development and through stimulating collaborative curriculum design. Although the importance of teacher development for curriculum change has been acknowledged for a long time, teachers' active involvement in collaboratively designing curriculum materials is recently becoming more prominent in educational practice (Simmie, 2007; Vescio, Ross, & Adams, 2008). A major reason is that traditional teacher development practices were found to be inadequate, not only for professional development but also for curriculum development and implementation, because of its passive nature (Borko, 2004; Lumpe, 2007). It is also generally accepted that curriculum change

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is not likely to succeed when teachers are merely viewed as practitioners who are expected to implement the plans of others (Ben-Peretz, 1990; Borko, 2004).

The common premise in all these teacher and curriculum development practices is that collaborative design positively affects both professional development and curriculum implementation. Recently, several studies have been published about the empirical basis of teachers' professional development and collaborative curriculum design in order to reach curriculum implementation and innovation (Drake, Land, & Tyminski, 2014; Penuel et al., 2007; Simmie, 2007; Voogt et al., 2011). With the teacher as the main link in the chain, there are two initial starting points for promoting curriculum innovation. On the one hand, teacher professional development is seen as the primary aim. The production and enactment of curriculum materials is considered more of a means, and the designs are by-products, such as the case in lesson study (Lewis, Perry, & Hurd, 2009). On the other hand, the emphasis is on curriculum innovation, and here professional development is considered a conditional process (Coburn, Russell, Kaufman, & Stein, 2012). From both perspectives, it is believed to be necessary to continually and actively engage teachers in the process of learning to become effective in curriculum development in order to contribute to their professional development.

In view of the increased attention for collaborative design in educational practice, the current study explored what empirical evidence is available about processes that take place when teachers co-design and how these contribute to professional development and curriculum change. In particular, the aim of our study was to determine the effects of participation of teachers in design teams on professional development and curriculum innovation processes, and thereby to target at effective mechanisms that determine designing in teams and the conditions under which these mechanisms are effective.

In the next sections, we discuss in more detail the relation between participation of teachers in design teams and its effects on teacher learning and curriculum practices, thereby aiming at identifying effective characteristics of designing in teams, to theoretically underpin the analyses that we carried out.

Theoretical underpinnings

In this study, we analysed a number of doctoral theses aiming to unravel the relation between teacher development and collaborative curriculum design and their contribution to curriculum innovation, identifying effects of collaborative design in teams on teacher development and on curriculum change, the effective mechanisms of collaborative design in teams that account for these effects, and the promoting or hindering conditions that affect collaborative design in teams. The theoretical underpinnings of these three aspects of collaborative curriculum design are described below. They form the theoretical basis of the analyses carried out.

Teacher learning in curriculum design teams: effects

The benefits of teachers collaboratively generating new knowledge about curriculum and teaching in schools or teams are increasingly recognized (Cober, Tan, Slotta, So, & Könings, 2015; Cochran-Smith & Lytle, 1993, 2009; Hubers, Poortman, Schildkamp, Pieters, & Handzelalts, 2016; Pareja Roblin, Ormel, McKenney, Voogt, & Pieters, 2014). Effects of teachers'

collaborative design on curriculum change have been reported by several scholars (Coburn et al., 2012; Penuel, McWilliams, et al., 2009; Penuel, Sun, Frank, & Gallagher, 2012). These effects pertained to curriculum design approaches, curriculum products, and sustainable and transferable teaching practices. Voogt et al. (2011) found that teachers' collaborative curriculum design contributes to the professional development of teachers in areas such as subject matter and systematic curriculum design skills. Penuel, McWilliams, et al. (2009) also found that curriculum implementation was reinforced by the incorporation of time for teachers to plan for implementation and the provision of technical support. These findings are consistent with studies on effective professional development (Ingvarson, Meiers, & Beavis, 2005; Walter & Briggs, 2012) and point to the significance of teachers' perceptions about the coherence of their professional development experiences with their own learning and with curriculum implementation (Garet et al., 2001; Penuel et al., 2007).

Teachers as co-designers in design teams: Mechanisms

Vescio et al. (2008) conclude, based on an overview of characteristics of professional learning communities (PLCs), that the PLC model represents a fundamental shift away from the traditional model of professional development. PLCs at their best are grounded in generation of knowledge of practice (Cochran-Smith & Lytle, 1999), whereas traditional models of professional development have typically been grounded in the assumption that the purpose of professional development is to convey to teachers knowledge *for* practice (Cochran-Smith & Lytle, 1999). In this study, we consider practices of teachers collaboratively designing curriculum as a specific form of a professional learning community. We argue that when teachers collaborate in design teams as co-designers of new curricula, processes of curriculum development and teacher professional development interact: Curriculum development activities can lead to increased professional development, and, in return, increasing professional expertise can lead to further improving curriculum development. Through the co-design process, teachers collaboratively generate knowledge of practice. As such, mechanisms are associated with the characteristics of the team and the processes within the team that lead to knowledge development with and of teachers.

In addition, the active involvement of teachers in collaborative curriculum design can improve the harmonization of the formal and the enacted curriculum, enhance teachers' ownership of the curriculum, and promote teachers' curricular collaboration (Penuel, McWilliams, et al., 2009). Such active involvement can only be effective when teachers themselves feel the need to change their practice, are convinced that their effort will bring about that change, and that they are indeed able to promote and install that change (Becuwe et al., 2015; Morris & Hiebert, 2011). The impact of teacher collaboration in design teams on both curriculum development and teacher professional development can be attributed to three effective theoretical principles: ". . . the situatedness of activity, agency, and the cyclical nature of learning and change" (Voogt et al., 2015, p. 261). "Situatedness" refers to the fact that the curricular problems that the teachers work on, and hence learn from, are the ones that are authentic and site based. "Agency" concerns the teachers' ownership and the individual and collective responsibility of the curricular change, as this originates from addressing their own curricular needs. The "cyclic nature of learning and change" refers to the interaction of the learning process with the cyclical nature of design. The cyclic

and iterative nature of the learning process takes place through the interactions with peers in the design teams and the external stimuli, the implementation in practice, and its effects on student outcomes, which may result in professional growth. These learning processes take place in the context of activities the teams carry out during the process of curriculum design, which can be visualized in the ADDIE model and concerns core activities related to analysis, design, development, implementation, and evaluation (ADDIE), respectively (Gustafson, 2002). Although the ADDIE model suggests a linear approach to curriculum design, Visscher-Voerman and Gustafson (2004) found in an analysis of practices of designers that these core activities often take place, but that the process is messy and not linear. In our study, the ADDIE model is only used to reveal the core design activities in the design practices of teacher design teams.

Collaborative design in teams: conditions

It has generally been accepted that for design teams to be effective support is needed (Becuwe et al., 2015; Binkhorst, Handelzalts, Poortman, & Van Joolingen, 2015). Binkhorst et al. (2015) see an essential role for a coach to support the design team. According to them, specific tasks for the coach are regulating the team's interactions, alignment of goals within the team, and providing structure in the activities the team carries out. Linder (2011) distinguishes between two forms of support: pro-active, which means that the support is designed based on the needs of the design teams, or re-active, support aligned with the process in the design team. On the basis of their study, Becuwe et al. (2015) argue that the coach of a design team should be able to adapt to the needs of the team. However, Svihla, Reeve, Sagy, and Kali (2015) showed that it is important to scaffold the design process, because teacher teams are often unfamiliar with the design process. This suggests that both forms of support are plausible and need to be complementary to each other.

In addition to support of a coach, the teams need support from the school leadership to realize the intended curriculum change. School leadership includes purposeful curriculum leadership, ensuring that student learning is taking place, teachers are being supported, collegiality is encouraged, vision and goals are developed and shared, and curriculum-developing efforts are well coordinated and aligned (Darling-Hammond, Meyerson, LaPointe, & Orr, 2009; Neumerski, 2013; Wiles, 2009). Efforts to improve teaching quality through collaboration build relational trust in a school (Penuel et al., 2007). Such trust allows leaders and teachers more latitude and discretion in making difficult decisions, creates clearer understandings of role obligations, and sustains commitment to improving student outcomes. Interactions among teachers constitute a resource for teachers in support of their implementation of reforms, which can be considered a form of social capital (Penuel, Riel, Krause, & Frank, 2009). The school leadership has an essential role in creating such a professional learning culture. Becuwe et al. (2015) formulated three institutional conditions that need to be in place for design teams to be effective. The first condition, a supportive attitude of the school leadership towards the concept of design teams, visible in the school policy, reflects the important role of the school leadership in creating a professional learning culture. The other two conditions provide facilitation structures for the work of the teams: the provision of time for the design work and time for a coach that supports the design team.

Research questions

The aim of our study was to determine the effects of participation of teachers in design teams on professional development and curriculum innovation processes, and thereby to target at effective characteristics of designing in teams. We collected evidence from 14 PhD studies on teacher collaboration in curriculum design and studied its impact on professional development, that is, on teacher learning and curriculum change. The following questions guided our analysis:

- What are the effects of teachers' involvement in design teams on teachers' learning?
- What are the effects of teachers' involvement in design teams on curriculum change?
- What mechanisms of collaborative design in teams account for the effects on learning and curriculum change?
- Which conditions affect collaborative design in teams?

Methods

Because we aimed at developing an in-depth understanding of the processes and effects of collaborative design in teacher teams on teacher learning and curriculum change, we applied the method of content analysis as a qualitative research strategy to analyse the dissertations.

Sample

In this study, 14 doctoral theses were analysed to answer the research questions. These theses resulted from a research programme (Pieters & Voogt, 2008) that investigated relationships between sustainable curriculum innovation and collaborative design in teams of teachers. Although scholarly articles have been published about the research conducted in the theses, the authors did not synthesize the evidence across studies. A characterization of the 14 studies is presented in Table 1. The PhD studies were chosen because they all covered the aspects that we aimed to identify: effects, mechanisms, and conditions. Most studies applied a combination of data collection instruments to study teacher learning and/or curriculum change, such as interviews (teachers/management), observations (lessons/team meetings), focus groups (teachers), questionnaires (teachers/students), and test and exam data. Data were collected to determine student performance and (sometimes) curriculum artifacts.

Analysis

We deliberately selected the *overall conclusions* and the *reflections on outcomes* of the theses as in these sections the authors generate explanations for their findings and formulate principles for developing collaborative design in teams. First, these sections were read to find key themes that describe (a) effects on teachers' learning and curriculum change, (b) mechanisms that account for teacher learning and curriculum change in teams, and (c) conditions that affect collaborative design in teacher teams. Second, the sections were re-read, and inductive coding was applied, which resulted in a refinement of the initial key

Table 1. Overview of the studies.

Author	Sector	Design team	Focus of the study	Focus of the reform	Designed products	Design	Enactment
1. Handelzalts (2009) The Netherlands	secondary education	secondary school teachers – same school	conditions for teacher design teams	school-wide reform: independent learning and cross-curriculum teaching of subjects	lesson series	x	some teams
2. Coenders (2010) The Netherlands	secondary education	secondary school teachers – different schools	teacher professional development	implementation of context-concept approach and student cooperation in science teaching	module	x	x
3. Bakah (2011) Ghana	higher education	university teachers – same university	teacher professional development	update of polytechnic curriculum relevant to industry	course syllabus	x	x
4. Nihuka (2011) Tanzania	higher education	university teachers – same university	teacher professional development	e-learning course design and delivery in distance education	courses	x	x
5. Alayyar (2011) Kuwait	higher education	pre-service teachers – same university	(pre-service) teacher professional development	ICT integration in pre-service science teacher education curricula	lessons	x	x
6. Agyei (2012) Ghana	higher education	pre-service teachers – same university	(pre-service) teacher professional development	ICT integration in pre-service math teacher education curricula	lessons	x	x
7. Akomaning (2012) Ghana	higher education	university teachers – same university	quality curriculum materials	enhancement of the quality of student internship	internship guide	x	x
8. Gendole (2013) Ethiopia	higher education	university teachers – same university	teacher professional development	implementation of communicative language teaching (CLT) in English language teaching	lessons (teacher guide/ handout)	x	x
9. Kafyulilo (2013) Ghana	higher education/ secondary education	secondary school teachers – same school/pre-service teachers – same university	development of knowledge and skills for integrating technology	ICT integration in pre-service and in-service science curricula	lessons	x	x
10. Cviko (2013) The Netherlands	primary education	kindergarten teachers – same school	teacher roles; effectiveness of ICT-rich learning environment	ICT-rich learning material for early literacy	learning activities	x	x
11. Huizinga (2014) The Netherlands	secondary education	secondary school teachers – same school	curriculum design expertise	implementation of Common European Framework of Reference (CEFR) in modern foreign language curriculum	series of lessons	x	x
12. Velthuis (2014) The Netherlands	higher education/ primary education	primary school teachers – same school/pre-service teachers – same university	science teaching self-efficacy	in-and pre-service teachers' professional development in primary science	lessons/ project	x	x
13. Albashiry (2015) Yemen	vocational education	heads of department and teachers – same vocational training college	enhanced design practices and curriculum consistency	enhanced quality of curriculum design practices and products	course syllabus	x	
14. Boschman (2015) The Netherlands	primary education	kindergarten teachers – same school	nature and content of design talk	ICT-rich learning material for early literacy	learning activities	x	

themes. In case we needed more detailed information on a specific theme, we went back to the original thesis. Third, to identify common patterns the codes were organized per theme (Miles & Huberman, 1994). Each step had been discussed in the research team until consensus was reached. Table 2 provides an overview of the key themes (the result of Step 3). Table 3 provides a description and examples of the codes, which were used for this analysis.

Results

Effects on teachers' learning

Collaborative design in teams helped teachers in the uptake of the pedagogy behind curriculum reforms, such as the context-based approach in science education (2, 12)¹ and communicative language teaching (8, 11). Bakah (3) and Gendole (8) report on the development of subject-matter knowledge, because of involvement in collaborative design in teams. For example, in the study of Bakah, several teams of lecturers from different engineering programmes at the level of a polytechnic decided to visit the industry as part of the redesign of a course. The team members attributed the development of subject-matter knowledge as well as the development of skills in using new technologies to these visits.

Studies that focus on the integration of technology in education (4, 5, 6, 9) in particular report that the (pre-service) teachers participating in design teams developed an in-depth understanding of the connections between technology, pedagogy, and subject matter at "the declarative, procedural, schematic and strategic level" (Alayyar, p. 114). These connections helped to understand the affordances of technology, for example, for describing concepts and processes that are difficult to visualize without technology (5, 6, 9) or to know when to use e-mail and short text messages to interact with students in a distance education context (4).

Several authors mention the development of curriculum design expertise related to the specific design task they dealt with in their teams (3, 4, 11, 13). Teachers develop clarity about the components that constitute a curriculum (13) and knowledge of procedures to systematically plan curriculum, by analysing current syllabi, determining structure, stating objectives, and discussing content (3, 4, 13), and they learn to take decisions about the design process and the products to be designed and the implications this has on classroom implementation (11). In addition, teachers learn to use strategies to involve external stakeholders during the design process (3, 11, 13).

Effects on curriculum change

As presented in Table 1, teachers' design activities in the teams result in concrete curriculum products, such as an internship guide (7), teacher and student material for communicative language teaching (8, 11), policy documents guiding curriculum development (11, 13), e-learning course materials (4), lesson materials (5, 6, 9, 11, 12) and re-designed course syllabi (3, 13). However, except in the studies that focused on pre-service teacher education (5, 6, 9), the quality of these tangible results of the design process has hardly been studied. The continued use of the designed materials in the educational institution can be considered a sustainable outcome of collaborative curriculum design in teacher

Table 2. Key themes across studies.

Author	Effects (RQ 1&2)		Mechanisms (RQ 3)				Conditions (RQ4)	
	teacher learning	curriculum change	prior knowledge/ experiences	analysis	design/ develop- ment	Implemen-tation/ evaluation	support	conditions: manage-ment/ external
1. Handelzalts				X	x	x	x	X
2. Coenders	x		x	x	x	x	x	X
3. Bakah	x		x	x	x	x	x	
4. Nihuka	x	x			x	x	x	x
5. Alayyar	x		x				x	
6. Agyei	x	x			x	x	x	
7. Akomaning		x		x	x	x	x	x
8. Gendole	x	x			x	x	x	x
9. Kafyulilo	x	x	x		x	x	x	x
10. Cviko		x	x		x	x	x	
11. Huizinga	x		x	x	x	x	x	x
12. Velthuis	x		x		x	x	x	x
13. Albashiry	x	x	x	x	x	x	x	x
14. Boschman			x		x		x	

Table 3. Codes, code descriptions, and example quotes.

Code	Description	Example quote
Effects – teacher learning	Effects on teacher learning, with respect to their knowledge & skills, self-efficacy, beliefs	"Their participation in curriculum design activities increased knowledge in curriculum design and content. Teachers became more skilled in discussing and describing content on the basis of curriculum components" (Bakah, p. 113)
Effects – curriculum change	Effects on curriculum change, with respect to materials and practices	"Consequently, <i>Collaborative Course Design</i> contributed to improved instructional practice, which addressed challenges of print-based delivery and leading to improved academic outcome of students" (Nihuka, p. 127)
Mechanisms –Teacher prior knowledge/ experiences	Characteristics of activities in the implementation and evaluation phase that contribute to the effects of collaborative design in teams	"Previous experiences from the participating teacher-developers with activities and materials, located in the Personal Domain (PD), and specific literature, serve as reference tools in deciding what to do regarding the texts, activities and assignments" (Coenders, p. 125)
Mechanisms – analysis	Characteristics of activities in the analysis phase that are reported to contribute to the effects of collaborative design in teams	"Delving into the syllabus to identify need areas for update and the process of reshaping content were learning grounds for teachers as they immersed themselves in their domains to ensure curriculum quality" (Bakah, p. 113)
Mechanisms – design/ development	Characteristics of activities in the design and development phase that contribute to the effects of collaborative design in teams	"In particular the need to collaborate in lesson design required the pre-service teachers to share knowledge and ideas and to explicitly reason and convince their peers about issues such as why certain topics could best be taught with spreadsheets and why they expect that certain learning activities contribute to students' learning" (Agyei, p. 177)
Mechanisms – implementation/ evaluation	Characteristics of activities in the implementation and evaluation phase that contribute to the effects of collaborative design in teams	"The classroom implementation experiences also gave the teachers chances to collaborate with their peers or facilitators, discuss their teaching issues, observe lessons/get lessons observed, receive/ provide feedback and reflect on the feedback individually or in pairs" (Gendole, p. 134)
Conditions – support	Characteristics of support that contribute to collaborative design in teams being effective	"Findings further showed that collaborative design in teams was effective when teachers were supported through collaboration guidelines, exemplary lessons, online learning materials and an expert with experience in science and education technology" (Kafyulilo, p. 124)
Conditions –management related	Characteristics of management-related conditions that contribute to collaborative design in teams being effective	"Presence of these coordinators (<i>management</i>) in team meetings had, for example, great impact on the teams' work. They had both a relational function and an information function. It seems then advisable that the coordinators apply a differentiated approach to teams, based on the teams' characteristics and the development that they show" (Handelzalts, p. 187)

(Continued)

Table 3. Continued.

Code	Description	Example quote
Conditions – external	Non-management related conditions that need to be in place for collaborative design in teams to be effective	“Further, the high rate of teachers’ and HoDs’ attrition and mobility in such contexts due to unsupportive work conditions forms another threat to the sustainability of systematic and relational curriculum design practices” (Albashiry, p. 100)

teams (7, 8). Gendole (8), for instance, reports that the head of department distributed the curriculum materials that were developed during the collaborative design process to all teachers in the department, also to those teachers not involved in collaborative curriculum design.

Teachers’ involvement in design resulted in improved curriculum design practices and consequently curricula with higher quality according to teachers and managers (4, 13). Teachers learn how to use a systematic approach by using procedures and templates. The teachers in Nihuka’s study (4) used templates to redesign course material developed for print-based learning to e-learning in a distance education setting. Albashiry (13) taught teachers and middle managers to address all curriculum components (rationale goals, content, teacher roles, learning activities, materials & resources, time, grouping, location and assessment) when redesigning course syllabi and to make sure that these are aligned. Several authors report about the strategies that teams apply to involve external stakeholders during the design process, such as sharing and discussing developed materials with colleagues in the department to create ownership (11), industrial visits (3), actively seeking information from industry partners (13), and sharing the results from a needs and context analysis with all stakeholders involved (7).

Finally, several authors (3, 4, 7, 10, 12) report about changed/improved instructional practice when enactment of the designed materials in teachers’ own practice is part of the design process. Involvement in the design process led to ownership of the new curriculum (7, 10), which enabled teachers to embrace the new curriculum products that were developed and foster the implementation of the new curriculum in practice (10). Similarly, involvement of all stakeholders in the design process contributed to ownership of the reform of all involved stakeholders – not only the teachers – and resulted in better internship practices (7). Velthuis (12) noticed that teachers who changed their way of science teaching as a result of participating in teacher design teams also increased their self-efficacy. Nihuka (4) found improved instructional practices when teachers used the e-learning materials they had designed. This not only enhanced access to courses, but also improved support to student learning and contributed to better student outcomes.

Mechanisms of teacher design teams that account for these effects

Teachers’ prior knowledge and experiences

Teachers’ prior orientations and experiences serve as a reference tool in the design process, which is therefore an important mechanism affecting the design process. Teachers try to accommodate the design task with their existing knowledge and beliefs, while at the same time realizing that involvement in the collaborative design of new

curriculum materials requires change and will affect their teaching (2). When becoming involved in the design of new curriculum materials, teachers' starting point is their existing pedagogical and subject knowledge and skills (9) and their experiences with curriculum design (11, 14). Teachers who have some experience in designing curriculum materials for others are better able to tackle design challenges (11). Yet, teachers who have prior experience with design for their own use may overestimate their knowledge and skills in curriculum design and underestimate the complexity of the curriculum design process when they have to design course syllabi at programme level (13). Positive prior experiences are used in the design of materials, while negative experiences do not affect the designed material as such, but the way the material is enacted (2).

Teachers might also bring outdated or insufficient knowledge about subject domain or pedagogy to the design process (3, 5, 14). This can be accounted for when teachers are aware of their lack of up-to-date knowledge, which was the case in the study of Bakah (3). However, outdated or insufficient knowledge and skills may negatively affect the quality of the designed materials when teachers are unaware of this (14). A strong belief about pedagogical approaches impacted the decisions teachers took about the kind of activities that they designed (14) and enacted (10). Positive views on technology positively affected the enactment of the design (10), but strong beliefs about the computer as a tool to facilitate independent learning limited teachers' understanding of technology in the design task (10).

Teachers' involvement in designing in teams

We used the phases described in the ADDIE model to present the mechanisms we found in the studies related to specific phases of the curriculum design process. In the *analysis phase*, teachers try to make sense of the design task. Teacher teams need time to understand the contours of the reform, to be able to develop a rationale for the reform (2), and to position themselves within the reform. This is particularly true for teacher teams whose ambitions and ideas of the curriculum reform are vague. These teams tend to linger in the analysis phase (1). However, often the analysis phase is skipped (1, 11).

Sharing the results of a need and context analysis helps teacher teams to develop a clear picture of the design task (3, 7, 13). The results of the needs analysis in Bakah's study (3) helped teacher teams to identify the areas in the curriculum that needed an update because of developments in industry. Results of a need and context analysis shared with middle managers responsible for curriculum design resulted in policy developments regarding curriculum design practices in the college, before teacher teams started with their design work (13). The policy documents served as a reference framework for the teams. In a study on internship practices, the results of the need and context analysis were shared among teachers and other stakeholders, such as students and representatives from industry, ensuing in a shared need for improved internship practices. As a result, teachers, students, and industry representatives provided input in the design task of the teacher teams (7).

Teacher teams differed in the way they conducted the *design and development phase*. In most studies analysed for this article, design and development were intertwined. Only in two studies (1, 2), design was done in the teacher teams, while individual members of the design team constructed the concrete materials. In this situation, the draft learning materials were discussed in the team, and suggestions from the discourse were

incorporated in a next version. Teachers felt that during the individual construction of the learning materials progress was made and considered it as one of the most efficient parts of the design process (1). However, most teacher teams designed and constructed the learning materials as a team. Boschman (14) characterizes the design process in the teams as a solution-driven approach. In an early stage of the design process, the teams, through brainstorming, try to quickly find a solution which they believe would work in practice. They then refine the solution, and reason and justify why this would work. Opportunities for teacher learning are particularly taking place during the process of reasoning and justification, and not so much during brainstorming. Without guidance, discussions in the teams during design mainly relate to the practicality of the plans, and not to substantive issues (1, 14). Substantive issues, when discussed, focus on content coverage (1) or concrete activities (14) instead of learning objectives. However, the majority of the teacher design teams were guided in their design process (see also “support”), which helped the teams to focus the conversations they had in the teams. During the design phase, teachers examined the existing course structure, formulated student outcomes, and sought input from industry representatives to make sure that the curriculum was up to date (3, 13). Velthuis (12) found that the most valuable activities during the design process of teams developing a primary science curriculum took place when the teams formulated design criteria for or made an overview of their science project. Through collaborative design in teams, teachers were invited to share knowledge, make their reasoning explicit, and convince their peers (3, 6, 9, 11, 12). Collaboration with peers in the design process offered windows to reflect on teachers’ own practice (2, 3) and expanded teachers’ personal knowledge (3, 14). The interdependency of the interaction in the teams strengthened the collective knowledge base from which the team could draw when designing curriculum material (3, 4, 7). However, for effective collaboration to happen, mutual trust and respect in the teams (3, 7, 9,) and emotional support (12) are important. The discourse in the teams during the design process required teachers to explicate their perceptions about the new curriculum, and how the new curriculum fits with and differs from their current curriculum. This helped to narrow the gap between the ideal and the operational curriculum (2, 8, 10) and to prepare themselves for classroom implementation. In addition, the involvement of external stakeholders during the design process in the setting of vocational education (3, 7, 13) led to easy adaptation of the new curriculum by these external stakeholders and fostered the implementation of the new curriculum in educational practice. Through the external input (see also “support”) and the discussions in the teams, an iterative process took place: “The process of writing, discourse and rewriting continues until consensus is reached” (Coenders, p. 125). This iterative process results in tangible curriculum materials, ownership of the reform of participating teachers and other stakeholders, and teacher learning.

The final phases in the ADDIE model comprise *implementation and evaluation* activities. In most studies, teachers enacted the designed curriculum materials in their own practice, and experiences were reflected upon in the teams. Active involvement in the design resulted in a high degree of integration of the curriculum materials in the classroom, because the materials fitted with classroom realities (10). Enactment helped teachers to get an image on how students interact with the material (1, 2, 3, 4, 9) and how to deal with challenges encountered in practice (8, 9). Particularly when student interaction with the materials and student results were unexpected, reflections in the teams on

these unanticipated outcomes led to cognitive conflicts that the teams tried to solve by adapting their design. It is particularly these experiences that lead to long-lasting change in knowledge and beliefs (2).

It is important to realize that enactment of new material is challenging for teachers, because they are hesitant to fail before their students (2, 9). To support teachers in enactment of the designed materials in practice, the teams can collaboratively prepare for it (3, 4). When possible, it is important to create safe environments for teachers to practise. For example, by fostering positive experiences during the first enactment of the designed material in educational practice (12). In pre-service education, often safe authentic teaching experiences are offered, when pre-service teachers enact their designed lessons in simulated lessons for peer students (6,9) and allow peers to provide feedback on the enacted practice of the lessons designed. Agyei (6) found that this was particularly important because it reduced pre-service teachers' anxiety in using technology and increased their enthusiasm. This is in line with the findings of Gendole (8), who used peer teachers to observe and provide feedback to practising teachers who enacted communicative language teaching. He found that peer support helped teachers to improve their teaching practice and was preferred above support from expert teachers because of the equal professional status between peers. However, implementation and evaluation activities beyond enactment and reflection in teachers' own practice are scarce (1, 11). We found that sharing the design as an implementation activity with teachers outside the design teams, who eventually will be affected by the design, proved to be a positive vicarious experience. Teachers in the teams were required to elicit and discuss their design and their design considerations, which fostered understanding of the new curriculum not only explicitly for the other teachers but also implicitly for the teachers in the teams. In addition, the involvement of external stakeholders during the design process in the setting of vocational education (3, 7, 13) promoted the adaptation of the new curriculum by these external stakeholders.

Conditions that affect collaborative design in teams

Support

Our results provide several reasons that advocate the need for support to teacher teams. First, teachers often have an incomplete image of the design task and need support in developing a clear picture of what is expected from them with regard to the process (1, 6, 9) and the product (1, 6, 13). Second, external support may trigger teachers' existing knowledge and beliefs and thus is a source for learning (2, 6, 8, 12). And third, teachers have an incomplete conceptual understanding of curriculum design, which makes them skip important parts of the curriculum design process, such as analysis and evaluation (1, 11), which may result in curriculum materials of low quality.

Both human and material support was offered to help the teacher teams to design new materials and to learn through their involvement in the design process. In the studies that we analysed, we found four kinds of support, including the two mentioned before.

Organizational support, in a pro-active manner, helped the teams to organize themselves: plan meetings, organize the venue, make appointments, and so forth. Often, organizational support was taken care of by the researcher or the team coordinator in close cooperation with the team. Organizational support was not always taken care of. In

such cases, the teams had to organize support by themselves, which was not always conducive to the collaborative design process, because it appeared difficult to realize regularity in the meetings of the teams (1). To structure the collaboration process, some teams were offered collaboration guidelines (7, 9).

Process support, as a kind of reactive support, helped the teams to structure the design process. Often, process support is taken care of by an external facilitator (usually the researcher or an external expert). To structure the design process, these external facilitators prepare assignments/activities the team has to carry out (3, 10, 14), offer templates the team can use to facilitate the design work (4, 13), or structure the design process using the ADDIE model (11, 12). External facilitators need to understand the curriculum design process themselves to be able to provide adequate process support (11). An important aspect of process support is to help the teams develop a concrete image of the design task in an early stage of the design process (1). This is done in several ways, for instance, by organizing an orientation workshop as an advance organizer to the design task (3, 6, 8, 9). In these workshops, several aspects of the design process are being addressed, such as the concept of collaborative design (3, 7) and the conceptual framework underlying the curriculum innovation (6, 9). Exemplary curriculum materials can serve as a means to give the teams an operational image of the design task (6, 9, 13). To prevent teachers from focusing on technology only, instead of pedagogy and content, when designing technology-enhanced lessons, Kafyulilo (9) provided the teams with a database of online resources the teachers could choose from. Technology that is easily available helps teachers to focus on lesson design and not on the technology, and hence results in better integration of technology in their teaching.

Expert support, either pro-active or reactive, helped the teams to develop an in-depth understanding of the curriculum innovation they are collaborating on. Experts bring new ideas to the team through their content, pedagogy, and/or technology expertise, which leverages the team's discussions (2). They often give input in the discussion by providing the teams with background materials on the innovation (2, 8, 12, 13). Experts may provide feedback on the curriculum materials that are being developed (5, 6, 9) and on the enactment of the designed materials in classroom practice (8, 9) or simulated practice (6).

Technical support, in a reactive way, was needed in some of the studies, where teachers collaboratively designed e-learning materials (4, 9, 10, 14). Nihuka (4) and Kafyulilo (9) provided technical support to solve technical problems during design and implementation, when necessary. Boschman (14) and Cviko (10) helped the teams in implementing the paper-based designs of the activities in the computer environment.

Leadership

The most important promoting factor for design teams to be able to work effectively and to produce the desired (and sustainable) outcomes is the involvement of the school leadership in the work of the teams. Hence, absence of leadership involvement is the most hindering factor. The school leadership can express their involvement by explicitly recognizing the work of the teams for the institution as a whole (1, 9, 11, 13) and through the facilities they offer to the teams (7, 8, 12).

Curriculum leadership skills help leaders to understand the need to maintain and enhance the curriculum, to develop clarity of the curriculum development expectations, and prevent leaders and teachers from underestimating the complexity of the design

task. However, these skills often need to be developed in school leaders (13). It is important for school leaders to have an overview of how the design teams work to be able to monitor the process of the curriculum renewal in their school. Through the occasional presence of school leaders at team meetings, the teams felt that their work was considered relevant by the leadership (1). Both the school leadership and the teams could exchange information, which positively impacted the work of the teams (1). An important role for the leadership is to make sure that the design teams share their work with colleagues that might be affected by their work (1, 11). Teachers in teams that were supported by the leadership were more likely to use technology in their teaching (the focus of the design task) than teams not supported by the leadership (9), and teams from schools without a vision on science teaching (the curriculum renewal at stake) and no support from the leadership used a large amount of time in the teams to discuss practical implementation issues (12). Design teams as an approach for professional development and curriculum renewal need to be part of the policies and plans of the leadership to be sustainable (8).

In order to develop professionally, teachers need time to internalize new knowledge and skills and change their beliefs (2). It also takes time to develop a curriculum that is both internally and externally consistent (13). From a practical perspective, it is therefore important that the leadership understands that design work takes time to obtain the desired outcomes. Several studies showed that a reduced workload in regular teaching tasks was a critical factor in the work of the teams (1, 4, 8, 13). They advocate the necessity of scheduled meetings that comply with the schedules of the institution and the participants to foster progress in the work of the teams. Studies conducted in developing countries mentioned the need for financial incentives for teachers who participated in the design teams (8, 13), because teachers in developing countries often have second jobs to earn a living. In such circumstances, financial incentives help to feel recognized and responsible for the design work.

External conditions

In addition, conditions outside the immediate influence of the leadership may promote or hinder the work and outcomes of design teams. A promoting factor is alignment of the design task with national curriculum reforms (2, 8, 9, 11), because it immediately shows the relevance of the work being done. In the study of Kayulilo (9), student teachers, on completion of their studies, participated in design teams, and therefore were involved in a national effort to increase in-service teachers' technology integration knowledge and skills. Hindering factors for the work in design teams were the high turnover of staff (7, 8, 13), the sometimes weak position of the middle leadership (7, 13), and the lack of liaisons with external partners (13).

Conclusion and discussion

The aim of our study was to determine the effects of participation of teachers in design teams on professional development and curriculum change processes and thereby to target at effective characteristics of designing in teams.

Our findings demonstrated that collaborative design in teams helped teachers to update their knowledge, in particular (technological) pedagogical content or subject-matter knowledge, and to develop practical skills related to using technology.

Furthermore, we found that teachers developed curriculum design expertise, including, in some studies, understanding the relevance and effectiveness of involving stakeholders in designing and implementing newly designed curricula. The effects of curriculum design teams, in terms of learning outcomes for teachers in areas such as (pedagogical) content knowledge and design knowledge and skills, became manifest in the outcomes of the curriculum design process, and in the appreciation by the stakeholders.

In addition, our study showed improved curriculum design practices, that were authentic and site based, and consequently curricula with a higher quality due to teachers' involvement in collaborative design endeavours. Teachers as co-designers developed ownership, the agency principle, of the curriculum reform, and this contributed to improved teaching practices. The curriculum products that were designed also proved to be important for the sustainability of the intended curriculum change. Enactment in teacher's own or colleague's practices resulted in positive changes in teaching practices. The design and enactment processes showed cyclical characteristics, and therefore proved to contribute to the learning by teachers involved in the design team.

A main focus of the study was on the mechanisms in design teams that account for the effects. Teachers' prior knowledge and experiences impacted the collaborative design process. Outdated or insufficient knowledge and skills may negatively impact the outcomes of the curriculum design process. However, the collaborative nature of the design process, in which teachers influence each other or are supported by experts, can lead to an improved quality of teachers' knowledge and skills and consequently advances the quality of the outcomes of the curriculum design process. Usually, a design process starts with the analysis phase. In this phase, teams analysed the current curriculum and searched for input in their design from other stakeholders, such as students and representatives from industry. The analysis phase often served as an advance organizer for the design process as a whole. Not all teams were able to operate effectively in this phase. Teams with vague or different goals (cf. Binkhorst et al., 2015) tended to spend too much of their time on this phase. All teams put emphasis on the design and development phase. Often, the design process was solution oriented: An initial solution was discussed in the teams and refined. The collaboration in the teams urged teachers to explicate their knowledge and reasoning and to reflect on their own practice in order to convince their peers. This resulted in a better understanding and ownership of the intended curriculum change, an important condition for successful implementation (cf. Penuel, Riel, et al., 2009).

The implementation and evaluation phase often concerned teachers' own curriculum and instructional practices. Reflections on the enactment experiences were discussed in the teams, and contributed to teacher learning and to adaptation of the design. Teams also learned from sharing their designed curriculum materials with other colleagues because they have to explicate the rationale behind their materials. However, teams do not often share their work with others.

Finally, we identified conditions that affect collaborative designing in teams. Our study demonstrated that teams need external support to enhance the curriculum design process and deliver quality products. Four forms of support were identified: organizational support, process support, expert support, and technical support. We confirmed the influential role of the leadership in promoting the design process, its outcomes, and the success of sustainability of the outcomes of the collaborative curriculum design process.

The presence of school leaders during the design process, whether physically present or explicitly supporting and showing concern for the team's activities, proved to be essential. In addition, encouragement by the leadership proved to be important in motivating staff and teachers to contribute to curriculum renewal through participating in a design team (cf. Becuwe et al., 2015).

Another promoting, and by absence a hindering, factor is the relevance of the work (to be) done (cf. Becuwe et al., 2015). Relevance can be demonstrated at a national level, for example, a national curriculum renewal, and in particular at the school level, for example, by changing curricular or instructional practices or adopting a new vision on teaching and learning. Other more practical but equally important and relevant factors are workload, time, and (financial) resources to be spent.

All the studies incorporated in this research took place in real-world settings. The outcomes of these studies can therefore be considered ecologically valid. The synthesis of findings we presented in this research is based on different contexts and cultures, which leads us to believe that our conclusions are valid for a diversity of settings.

Our study also shows some underresearched aspects of collaborative design in teacher teams. Although we do not pretend to be exhaustive, we propose six lines for further study. First, the dissertations in our sample mainly focused on the effects of design teams on teachers, but the effects on outcomes for students were hardly addressed. Although we agree that it is difficult to study the relationship between collaborative design in teams and student learning outcomes, we do think that it is important to better understand this relationship. The meta-analysis from Lomos, Hofman, and Bosker (2011) about effective professional learning communities with respect to student achievement might be helpful as a first step. Second, we were surprised that in our sample of studies not much attention has been paid to the quality of the designed curriculum materials. We see the quality of the materials as having to be conditional for the intended student outcomes, and, in our view, this should not only be a concern of research but also of the teams. Third, little is known about the complexity of the design tasks that teacher teams can and should handle. In our view, the relationship between national or state curriculum design efforts and the implications and conditions for curriculum design in schools need further study; particularly when schools have more autonomy in their curriculum, which is increasingly the case in many countries (Law & Nieveen, 2010). Fourth, we think that the relation between teacher design teams and teachers that are affected by their work needs to be studied, because teacher teams may hinder curriculum implementation if they do not put efforts in the relational aspect of curriculum design (Jonker & Voogt, 2015; Kessels & Plomp, 1999). Fifth, whereas we did not include the focus of the teams in our analysis, future analysis of design teams might consider the aim of the team, whether it is in particular aimed at professional development or aimed at performing a certain task, for example, curriculum design. Finally, more research is needed about the scalability and sustainability of collaborative curriculum design (process and outcomes) in teacher teams (cf. Coburn, 2003).

The benefits of teachers generating new knowledge about curriculum and teaching through design teams have been confirmed by our study. Our study showed that professional development, in the form of collaborative design in teams, which is specific and linked to the curriculum, influences teachers' knowledge and practice and impacts implementation of curriculum reform.

Note

1. See Table 1 for the studies to which the numbers refer.

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References

(*The doctoral studies analysed for this article)

- *Agyei, D. D. (2012). *Preparation of pre-service teachers in Ghana to integrate information and communication technology in teaching mathematics* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from <http://doc.utwente.nl/80660>
- *Akomaning, E. (2012). *Improving student internship through collaborative curriculum design in Ghanaian polytechnics* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from <http://doc.utwente.nl/83970/>
- *Alayyar, G. (2011). *Developing pre-service teacher competencies for ICT integration through design teams* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from <http://doc.utwente.nl/77918/>
- *Albashiry, N. M. (2015). *Professionalization of curriculum design practices in technical vocational colleges. Curriculum leadership and collaboration* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from <http://doc.utwente.nl/96806/>
- *Bakah, M. A. B. (2011). *Teacher professional development through collaborative curriculum design in Ghanas Polytechnics* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/78306/1/thesis_MAB_Bakah.pdf
- Becuwe, H., Pareja Roblin, N., Van Braak, J., Tondeur, J., Castelein, E., & Thys, J. (2015). Conditions voor de succesvolle implementatie van leergemeenschappen: De casus van Teacher educator Design Teams voor ICT-integratie [Conditions for successful implementation of professional learning communities: The case of teacher educator design teams for technology integration]. *Tijdschrift voor Lerarenopleiders*, 36(4), 5–16.
- Ben-Peretz, M. (1990). *The teacher-curriculum encounter*. Albany, NY: State University of New York Press.
- 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.
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, 33(8), 3–15.
- *Boschman, F. B. (2015). *Collaborative design of ICT-rich early literacy learning material: Design talk in teacher teams* (Doctoral dissertation). Enschede, The Netherlands: University of Twente.

- Cober, R., Tan, E., Slotta, J., So, H.-J., & Könings, K. D. (2015). Teachers as participatory designers: Two case studies with technology-enhanced learning environments. *Instructional Science*, 43, 203–228.
- Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher*, 32(6), 3–12.
- Coburn, C. E., Russell, J. L., Kaufman, J. H., & Stein, M. K. (2012). Supporting sustainability: Teachers' advice networks and ambitious instructional reform. *American Journal of Education*, 119, 137–182.
- Cochran-Smith, M., & Lytle, S. L. (1993). *Inside/outside: Teacher research and knowledge*. New York, NY: Teachers College Press.
- Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education*, 24, 249–305.
- Cochran-Smith, M., & Lytle, S. L. (2009). *Inquiry as stance: Practitioner research for the next generation*. New York, NY: Teachers College Press.
- *Coenders, F. (2010). *Teachers' professional growth during the development of context-based chemistry student learning material* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/71370/1/thesis_F_Coenders.pdf
- *Cviko, A. (2013). *Teacher roles and pupil outcomes in technology-rich early literacy learning* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/88947/1/thesis_A_Cviko.pdf
- Darling-Hammond, L., Meyerson, D., LaPointe, M., & Orr, M. T. (2009). *Preparing principals for a changing world: Lessons from effective school leadership programs*. San Francisco, CA: Jossey-Bass.
- Drake, C., Land, T. J., & Tyminski, A. M. (2014). Using educative curriculum materials to support the development of prospective teachers' knowledge. *Educational Researcher*, 43, 154–162.
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38, 915–945.
- *Gendole, A. A. (2013). *Collaborative teacher professional development in Ethiopian higher education: The case of collaborative language teaching* (Doctoral dissertation). Enschede, The Netherlands: University of Twente.
- Gustafson, K. L. (2002). Instructional design tools. A critique and projections for the future. *Educational Technology Research and Development*, 50(4), 59–66.
- *Handelzalts, A. (2009). *Collaborative curriculum development in teacher design teams* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/67385/1/thesis_A_Handelzalts.pdf
- Hubers, M. D., Poortman, C. L., Schildkamp, K., Pieters, J. M., & Handelzalts, A. (2016). Opening the black box: Knowledge creation in data teams. *Journal of Professional Capital and Community*, 1, 41–68.
- *Huizinga, T. (2014). *Developing curriculum design expertise through teacher design teams* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/93179/1/thesis_T_Huizinga.pdf
- Ingvarson, L., Meiers, M., & Beavis, A. (2005). Factors affecting the impact of professional development programs on teachers' knowledge, practice, student outcomes & efficacy. *Education Policy Analysis Archives*, 13(10). doi:10.14507/epaa.v13n10.2005
- Jonker, H., & Voogt, J. (2015, June). *De invloed van het sociale netwerk van een DocentOntwerpTeam op de innovatiebereidheid van docenten* [The impact of the social network of a teacher design team on teachers' willingness to innovate]. Paper presented at the Onderwijs Research Dagen, Leiden, The Netherlands.
- *Kafyulilo, A. C. (2013). *Collaborative design in teams to develop science and mathematics teachers' technology integration knowledge and skills* (Doctoral dissertation). Enschede, The Netherlands: University of Twente.
- Kessels, J., & Plomp, T. (1999). A systematic and relational approach to obtaining curriculum consistency in corporate curriculum consistency in corporate education. *Journal of Curriculum Studies*, 31, 679–709.
- Law, E. H.-F., & Nieveen, N. (Eds.). (2010). *Schools as curriculum agencies: Asian and European perspectives on school-based curriculum development*. Rotterdam, The Netherlands: Sense.
- Lewis, C. C., Perry, R. R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal of Mathematics Teacher Education*, 12, 285–304.

- Linder, S. M. (2011). The facilitator's role in elementary mathematics professional development. *Mathematics Teacher Education and Development*, 13(2), 44–66.
- Lomos, C., Hofman, R. H., & Bosker, R. J. (2011). Professional communities and student achievement – A meta-analysis. *School Effectiveness and School Improvement*, 22, 121–148.
- Lumpe, A. T. (2007). Research-based professional development: Teachers engaged in professional learning communities. *Journal of Science Teacher Education*, 18, 125–128.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.
- Morris, A. K., & Hiebert, J. (2011). Creating shared instructional products: An alternative approach to improving teaching. *Educational Researcher*, 40, 5–14.
- Neumerski, C. M. (2013). Rethinking instructional leadership, a review: What do we know about principal, teacher, and coach instructional leadership, and where should we go from here? *Educational Administration Quarterly*, 49, 310–347.
- *Nihuka, K. (2011). *Collaborative course design to support implementation of e-learning by instructors* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/78096/1/thesis_K_Nihuka.pdf
- Pareja Roblin, N. N., Ormel, B. J. B., McKenney, S. E., Voogt, J. M., & Pieters, J. M. (2014). Linking research and practice through teacher communities: A place where formal and practical knowledge meet? *European Journal of Teacher Education*, 37, 183–203.
- 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, 921–958.
- Penuel, W. R., McWilliams, H., McAuliffe, C., Benbow, A. E., Mably, C., & Hayden, M. M. (2009). Teaching for understanding in earth science: Comparing impacts on planning and instruction in three professional development designs for middle school science teachers. *Journal of Science Teacher Education*, 20, 415–436.
- Penuel, W. R., Riel, M., Krause, A., & Frank, K. (2009). Analyzing teachers' professional interactions in a school as social capital: A social network approach. *Teachers College Record*, 111(1), 124–163.
- Penuel, W. R., Sun, M., Frank, K. A., & Gallagher, H. A. (2012). Using social network analysis to study how collegial interactions can augment teacher learning from external professional development. *American Journal of Education*, 119, 103–136.
- Pieters, J. M., & Voogt, J. M. (2008). *Curriculum, docent en innovatie* [Curriculum, Teacher and Innovation] (Research program of the Department Curriculum Design and Educational Innovation). Enschede, The Netherlands: University of Twente.
- Simmie, G. M. (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, 163–176.
- Svihla, V., Reeve, R., Sagy, O., & Kali, Y. (2015). A fingerprint pattern of supports for teachers' designing of technology-enhanced learning. *Instructional Science*, 43, 283–307.
- *Velthuis, C. (2015). *Collaborative curriculum design to increase science teaching self-efficacy* (Doctoral dissertation, University of Twente, Enschede, The Netherlands). Retrieved from http://doc.utwente.nl/91143/1/thesis_C_Velthuis.pdf
- 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, 80–91.
- Visscher-Voerman, J. I. A., & Gustafson, K. (2004). Paradigms in the theory and practice of education and training design. *Educational Technology, Research & Development*, 52(2), 69–89.
- Voogt, J. M., Laferrière, T., Breuleux, A., Itow, R., Hickey, D. T., & McKenney, S. (2015). Collaborative design as a form of professional development. *Instructional Science*, 43, 259–282.
- Voogt, J. M., Westbroek, H., Handelzalts, A., Walraven, A., McKenney, S., Pieters, J., & De Vries, B. (2011). Teacher learning in collaborative curriculum design. *Teaching and Teacher Education*, 27, 1235–1244. doi:10.1016/j.tate.2011.07.003
- Walter, C., & Briggs, J. (2012). *What professional development makes the most difference to teachers*. Oxford, UK: Oxford University Press.
- Wiles, J. (2009). *Leading curriculum development*. Thousand Oaks, CA: Corwin Press.