Chapter 3
Teachers as Co-designers: Scientific and Colloquial Evidence on Teacher Professional Development and Curriculum Innovation

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Introduction

Teacher participation in the collaborative design of curriculum materials is gaining momentum in educational practice. In collaborative design teams, teachers create new curricular materials such as courses or lessons in co-operation with each other, and often also with experts from the educational design, educational research, and educational content domains. Projects that involve collaborative design have different aims. At one end of the spectrum, professional development is seen as the primary aim. The production and enactment of curricular materials is considered more of a means and the designs are by-products. The lesson study approach (cf. Lewis, 2000) is a typical example of this. This increasingly popular professional development arrangement aims at gaining insight into the learning processes of students within a specific academic domain by co-designing one exemplar lesson in a cycle of design–enactment-evaluation–redesign.

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At the other end of the spectrum, the emphasis is on curriculum innovation. Typical examples are the recent large-scale science curriculum reform projects in the Netherlands and Germany. These projects used collaborative design as an implementation-furthering strategy. A common premise is that collaborative curriculum design not only positively affects professional development but that this can result in a curriculum innovation as well (Fig. 3.1) (Borko, 2004; Koehler & Mishra, 2005).

Although the premises behind collaborative design are conceptually well-founded, their empirical base is less evident (Borko, 2004; Voogt et al., 2015). Therefore, and particularly in view of the increased attention to collaborative design in educational practice, the study presented here was undertaken to explore what empirical evidence is available about processes that take place when teachers co-design, how these contribute to professional and curriculum development, and what are fostering and hindering factors. Additionally, we searched for what has been reported about the possible effects on curriculum enactment.

Scientific, peer-reviewed articles were searched and analysed, using the following broad definition of collaborative design: at least two teachers who cooperatively (re)design curriculum materials with the aim of improving educational practice (Handelzalts, 2009). We additionally searched professional journals for colloquial evidence, for two reasons: to demonstrate that collaborative design is topical in practice as well, and to include more direct reports on teacher experiences. Colloquial evidence (cf. Wenger & Snyder, 2000) can be defined as descriptive and/or evaluative reports on design teams as portrayed in professional journals by teachers. The term 'colloquial evidence' stems from research on health care (cf. Lomas, Culyer, McCutcheon, McCauley, & Law, 2005). Such first-hand information on teacher experiences enabled us to compare teacher perspectives with researcher perspectives in an exploratory way.

Theoretical Background

The idea of involving teachers in collaborative curriculum design is, in an important sense, a reaction to traditional curriculum reform movements that have emerged over the past decades, as well as to the felt need that curriculum development needs to be more dynamic in response to a rapidly changing world. A curriculum is a plan for

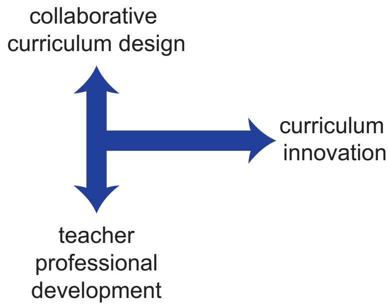

Fig. 3.1 Teachers who are involved in collaborative curriculum design experience professional development. The premise is that these two processes strengthen each other and can lead to curriculum innovation

learning (Taba, 1962). A curriculum is made manifest through various curriculum materials that can be designed at different levels of representation: standards are often developed on a national level, while on a classroom level, teachers design learning experiences for their students: units, lessons, activities, tests. How a plan for learning plays out in terms of actual student experiences and learning outcomes is ultimately determined by the way the designs are enacted by the teacher (Remillard & Heck, 2014). Teacher collaborative design typically applies to the classroom level (Voogt et al., 2011).

Collaborative curriculum design can take many forms that exhibit roughly two different models of curriculum innovation. On the one hand, in school-based collaborative design settings in which teachers cooperate to set goals and improve their practice (Handelzalts, 2009), teachers are seen as active agents and initiators of change (Severance, Penuel, Sumner, & Leary, 2016; Voogt et al., 2015). How teachers fulfil their role of 'change agent' might range from being modest adapters to being innovative. On the other hand, other initiatives have used teacher design teams to translate reform proposals into lesson materials as an implementation-furthering strategy (e.g., Parchmann et al., 2006). This approach does not fundamentally change the basic model of traditional curriculum reform. In this model, curriculum reform is initiated by 'others'. Instead of being a change agent, the teacher is the end-user who needs to 'fix' deficiencies in knowledge and beliefs, in order to properly understand and adopt the proposed curriculum reform and design and enact lesson materials accordingly. The impact of such traditional curriculum innovation initiatives has been poor: there is ample evidence that transformation of the intended design processes into classroom practice involves adaptation more often than not, and in most cases has resulted in a loss (slippage) of the initial innovative ideals (e.g., Remillard, 2005; Westbroek, Janssen, & Doyle, 2016). It is assumed that involving teachers at an early stage of curriculum reform at least narrows the gap between the initial intentions and enactment, because greater ownership is fostered and collaborative design can anticipate the types of adaptations teachers might likely make (e.g., Doyle & Ponder, 1977; Handelzalts, 2009).

Involving teachers in co-designing curricular materials is additionally assumed to comply with various features of effective teacher professional development. The design process itself is considered to require distinctive types of 'design practices' in moving from a conceptual idea to a product (cf. Naidu, Anderson, & Riddle, 2000). The process of collaborative design thus involves recursive (re)consideration, making design decisions based on articulated expectations and observing how the design actually functions in the classroom. If a new teaching approach is integrated into the curriculum materials, areas of difficulty may emerge that can be collaboratively discussed in the design team. Thus, collaborative design is geared toward actual practice: design, enactment and evaluation of artefacts based on insights into how to guide students' thinking and how to use these artefacts in practice (Borko, 2004; Van Veen, Zwart, Meirink, & Verloop. 2010). Furthermore, collaborative design is social in nature. It provides opportunities for collaboration with peers and experts which, in turn, can create opportunities for reflection on new teaching experiences (Borko, 2004; Lumpe, 2007; Voogt et al., 2011). A review of 82 studies showed that teachers who learn collaboratively tend to use more innovative pedagogies, better align written and enacted curricula, increase professional communication and display more job satisfaction and self-efficacy (Van Grieken, Dochy, Raes, & Kyndt, 2015).

In sum, we can conclude that there is sufficient theoretical basis for collaborative design. However, its empirical base is less solid. Therefore, in this study we address the following question: *From the perspectives of practitioners and researchers, respectively, what do empirical studies say about the processes of collaborative design and their effects on teacher professional development, curriculum development, and curriculum enactment?*

In this study we included colloquial evidence derived from professional papers to demonstrate that collaborative design is topical in educational practice, and to include teachers' perspectives in our analysis. The colloquial corpus reveals problems, experiences and results that teachers consider worthwhile to share with their colleagues, not being directed by a research agenda. Including colloquial evidence provides a unique picture of, in this case, Dutch teachers participating in collaborative design, and subsequently enabled us to identify what might be blind spots in the scientific corpus.

Method

Peer-reviewed articles published between 1988 and 2009 were included in this study. Initial systematic searches in three major databases, Scopus, Web of Science, and Eric, yielded 492 articles. A combination of the following search terms was used: teacher; different synonyms of curriculum design/innovation/or material development or teacher developed materials/teaching materials/lesson materials; different synonyms of collaboration/participation. The results from all databases were combined and controlled for overlap.

Additionally, 25 popular and well-used Dutch professional journals that address general and domain-specific pedagogical and instructional topics were selected. Because electronic indexing is not yet common for these sources, Dutch journals from only 1 year of publication (2008) were hand-searched. For those journals publishing fewer than four times annually, issues from 2007 were also included. We consider this study as a first step in including a colloquial body of evidence in a scientific literature review in order to examine and compare practitioners' perspectives and researchers' perspectives on the topic of collaborative curriculum design.

Both the scientific and professional articles had to meet the following criteria to be included in this study:

1. activities described involve at least two teachers co-designing;
2. activities described cover (part of) a design cycle: problem analysis, design, enactment, evaluation and redesign;
3. activities described contribute to the realization of a curricular product, such as national syllabi, learning materials.

This chapter reports on the collection and interpretation of data or – in case of the professional articles–experiences. Theoretical articles were excluded from the study. Professional articles that concerned a scientific study presented by researchers were also excluded. In the first screening, the abstracts of the scientific articles ($n = 492$) were independently examined by three researchers for meeting the inclusion criteria. Differences in judgment were discussed until agreement was reached. The inter-screener reliability was considered sufficient (Cohen's kappas: 0.64, 0.67 and 0.68). Based on this screening, 319 articles were labelled as not-relevant, 173 as relevant. Next, the full-text articles were screened. The level of agreement between two researchers ranged from substantial (Cohen's kappas of 0.68 and 0.77) to quite strong (0.86). Based on the full-text screening, another 144 articles were labelled as not-relevant, 29 as relevant. Not-relevant included being theoretically rather than empirically oriented. A substantial number of articles also only presented summative evaluations of the design products instead of scientific reports on the process of collaborative design. The scientific articles were additionally judged on specific quality criteria, such as consistency and presence of appropriate measurements to secure validity (cf. Campbell et al., 2003). Sixteen articles were considered of 'insufficient' quality, and were therefore excluded from the study. Of the remaining 13 articles, 9 concerned in-service teachers and formed the basis for this study (Table 3.1). Four articles concerned collaborative design by pre-service teachers and were excluded from the review.

The professional journals ($n = 25$) were hand-searched on (sub)titles and abstracts of articles that seemed to follow the inclusion criteria. This resulted in a data set of 35 articles. Next, two researchers independently screened the articles. Most (23) of the 35 articles did not meet the criteria. In many cases, the articles concerned a scientific study presented by researchers. The researchers reached a 100% consensus on which articles to include after short discussions of the relevant articles. The final data set contained 12 articles for further analysis (Table 3.1).

Table 3.1 Overview of the selected scientific and professional papers

Scientific papers	Professional papers
Baildon and Damico (2008)	Baack (2008)
Deketelaere and Kelchtermans (1996)	Boerstoel and Wielaard (2008)
Fernandez (2005)	Dijkstra (2008)
George and Lubben (2002)	Heijn and Krüger (2008)
Parchmann et al. (2006)	Hoekzema (2008)
Rock and Wilson (2005)	Hollaardt (2007)
Schneider and Pickett (2006)	Koelemij and Visscher-Meijman (2007)
Shkedi (1996)	Oosterling (2008)
Voogt, Almekinders, Van den Akker, and Moonen (2005)	Van den Broek (2007)
	Van der Westen (2008a)
	Van der Westen (2008b)
	Visser (2008)

Both the professional and scientific articles were analysed with the following questions:

1. What are the main characteristics of the design teams and the design processes?
2. What effects on teachers' professional development are reported?
3. What effects on curriculum enactment are reported?

Cross-article analyses were carried out to identify themes and patterns, dominant characteristics, processes, and effects of collaborative design (cf. Campbell et al., 2003; Noblit & Hare, 1988). The results of both the scientific and the colloquial cross-article analyses were discussed by the entire research team.

Results: The Colloquial Corpus

The selected articles were written by teachers ($n = 5$) or intermediaries from consultancy offices ($n = 7$). Ten articles concerned secondary education, two concerned primary education. The products designed varied from a small series of lessons to new instructional approaches such as collaborative and inquiry learning. Table 3.2 presents brief summaries of the projects.

Characteristics of the Design Teams

The design teams were either: (a) local and working in the same school ($n = 5$), or (b) regional/national with members from different schools ($n = 7$). On average, teams had about ten members. At primary schools, design teams encompassed the whole school team; at secondary schools, domain-specific departments usually formed the natural boundaries of the team. The teams either dealt with curriculum renewal by adopting new pedagogies and classroom organizations ($n = 4$) or with improvement of domain-specific lesson materials ($n = 8$). These domains varied from science to the languages and art. The vast majority of teams also had external members who helped coordinate the teams and inspired members with procedures and/or new content ($n = 9$). These external members came from general pedagogical institutes or domain-specific learning centres/university departments. Overall, the general picture in the colloquial corpus was a rather large multidisciplinary team of teachers and intermediaries/researchers from the educational field, in which teachers outnumbered external experts.

Table 3.2 Summaries of the professional projects

Study	Summary of the project
Baack (2008)	A team of eight foreign language teachers at one secondary school designed and implemented a new form to assess students' fluency during 1 year. Two prototypes were designed and tested. The teachers shared their experiences and the students' results. The teacher design team reported a more objective scoring procedure, and more explicit criteria for both the teachers and students, and higher foreign language fluency was noticed
Boerstoel and Wielaard (2008)	A team of members from five secondary schools designed and implemented a project-based curriculum with students engaged in self-regulated learning and teachers as coaches. The teacher design team used a design model that was developed and tested in the US. The new curriculum was evaluated through interviews with teachers and students, students' journals of students and classroom observations. Anecdotal proof from teachers and students was provided to illustrate positive outcomes such as new learning results and a quiet learning environment
Dijkstra (2008)	A team of members from five primary schools designed an adaptive curriculum for mathematics and language learning that aimed to divide students into either a pre-vocational or pre-scientific route. The teacher design team hoped to improve the students' learning process and give children more opportunities to experience success. The project ran for 3 years and was supported by an institute specializing in supporting weak students. The teacher design team reported positive effects on their own professional development as far as realizing adaptive teaching. The main curricular effect that was reported concerned an adjustment of end levels in the upper grades of the primary schools
Heijn and Krüger (2008)	Teachers from many different secondary schools supported by domain experts from universities teamed up to design new lesson materials for an interdisciplinary science program. A nation-wide project group consisting of different stakeholders monitored the process of implementation. The article described several lesson materials that were designed. No user evaluations were reported
Hoekzema (2008)	A team of teachers from nine secondary schools, supported by university teachers, designed web quests that help their students make more effective choices of a profession and university course of study. The project ran for several years. Anecdotal proof based on observations and informal interviews was provided for the lessons' effectiveness, as students seemed to gain insight into what certain professions really encompass in practice, and what they like to do and are good at. The teachers reported they had learned more about their students' worries and motives
Hollaardt (2007)	A team of teachers from two secondary schools designed new lesson materials for a multidisciplinary science program. They were supported and monitored by a nation-wide project group. The lesson materials aimed at showing the relationship between the disciplines involved, and at supporting problem-based inquiry by students. The article reported positive findings concerning interdisciplinary collaboration by teachers during the design process, as they got to know each other's learning content and found new opportunities to become fine-tuned with each other's programs

(continued)

Table 3.2 (continued)

Study	Summary of the project
Koelemij and Visscher-Meijman (2007)	A team of teachers at one primary school implemented a teaching model designed by others. Supported by educational experts, the team translated the general model into a school-specific curriculum aiming at more self-regulated learning and enhanced classroom organisation. The project ran for 4 years. The team developed their classroom practices in a cycle of design, implementation and evaluation. The evaluation was based on videotaped classroom observations and team-wide coaching. The teachers also observed their own practice to collect learner experiences. Positive findings were reported for teachers and students, as well as teams
Oosterling (2008)	Five pre-service teachers designed and implemented new lesson materials for mathematics that were aimed at motivating students to apply mathematical rules to daily problems. The project ran for 2 years and was supported by domain experts from universities and educational counsellors. Positive learner evaluations, and the teachers' ownership and enthusiasm were illustrated with citations from interviews. Lesson materials were extensively described and visualised, with the aim of sharing new materials and teachers' experiences
Van den Broek (2007)	Teachers from one secondary school developed a new mathematics curriculum that aimed to actively engage learners in doing mathematics. The project was started in the early 1970s and continued up to date to keep the 'Wageningse method' current. Other teachers from other schools joined the teacher design team to add their new materials across the years
Van der Westen (2008a, 2008b)	A school-wide team of teachers from a secondary school designed and implemented a so-called 'vocabulary portfolio' in which students wrote down newly learned words and their meaning, to improve learners' fluency and level of speaking. The portfolio was used across subjects. Per subject department, smaller teacher design teams designed and implemented use of the portfolio within their lessons. Several students participated in the project by attending department meetings to monitor the proceedings. The projects ran for 3 years. The project was monitored by classroom observations and interviews. No results were presented yet
Visser (2008)	A team of English teachers from one secondary school designed and implemented an extra curriculum for students who need a more challenging program. The team was supported by educational experts. The project ran for 2 years. The team kept a journal of its proceedings during weekly meetings to share their findings with other foreign language teachers. Anecdotal evidence from learners was collected to prove positive findings related to motivation and outcomes. In addition, teachers experienced a shared vision of instruction and reported experiences that were also beneficial for their regular classes

Characteristics of the Design Process

Many of the articles started with describing the design problem that teachers observed in their practice. For instance, teachers noticed that their students were not motivated to do mathematics and started searching for new and more challenging ways of teaching. In one article (Hoekzema, 2008), the practice-based starter for redesign was put as follows:

> Many upper secondary school students do not seem to choose the right vocational study. Their chances for failure in the near future are huge, and many freshmen change their majors later on. A group of nine schools decided to do something about that. (p. 54)

The colloquial corpus was larded with strong affective statements about how the design problem is personally experienced, and with personal wishes for improvement, indicated by sentence starters such as 'At *my* school....', '*I* really would *like*...', and 'Like many of my colleagues *I noticed* with my students that they...' [italics added]. Hence, what ultimately motivated teachers to re-design their context was not a new scientific insight on how to do things, but a deeply felt and experienced problem in their own teaching practice. This focus also determined how teachers evaluated success.

In addition to a personally felt need for redesigning, teachers mainly began by drawing upon their own expertise to improve their learning environments. In many cases, they also got input (knowledge, skills, procedural support, materials) from specialists in the field, such as design experts. They seemed to reach out to a lesser extent for new scientific insights provided by universities or scientific journals ($n = 1$).

The articles gave extensive descriptions of the designs produced by the design teams. The backgrounds and different parts of the designs were presented, and illustrated with pictures of the materials. Often, the design teams used several iterations of designing, implementing, and evaluating to reach their final products. However, these cyclic processes were not documented systematically.

Effects on Teachers' Professional Development

The colloquial corpus suggested that participating in collaborative design had positive effects on teachers' ownership of the curriculum they plan. The teachers strongly identified with the goal, activities and results, and their personal judgements played a crucial role in the claims they made. The articles indicated that collaborative articulation of a problem enhanced a teacher's motivation to redesign his or her daily practice. All articles reported personal involvement of the teachers and an eagerness to actively contribute to change: "I really like collaborative designing. It is a good thing if teachers do this. We stand squarely in practice and have developed a strong sense of what is possible and what isn't in the classroom" (Hollaardt, 2007, p. 17). This readiness was also apparent in the way design products and learning processes that sprang from the collaborative designing were presented: extensively, with pride and affective wordings, as illustrated by:

> We are very proud of what we have arrived at. The lesson series runs very well and seems to have been given a strong position in the school curriculum. We have worked with much enthusiasm, and have more new schools interested in it than we can handle. (Oosterling, 2008, p. 27)

A second effect that became apparent was that collaborative design positively contributed to personal and social growth: team building, a broadening of task perception and collaboration skills. Many articles reported that the school or department team developed a common language and school vision, which paved the way for improvement of design processes and products, for example:

> It has become much more normal to discuss problems with each other, and help each other find solutions. Observing lessons, watching videotapes of lessons, and visiting each others' classrooms stimulate this sharing of ideas and have become normal now. This strongly influences our school climate and stimulates continuing development in the school. (Koelemij & Visscher-Meijman, 2007, p. 34)

Some articles additionally reported increased understanding of and better collaboration with students ($n = 4$). During the process of designing and evaluating, students were asked to articulate their experiences and appreciations, or, in one case, were invited to help the teachers redesign their lessons. As a result, teachers gained insight into how students were thinking about their lesson.

> Well, what we found was that prevocational students are very relational, are smart, can work independently to a certain extent, work well with practice-oriented assignments and prefer short-term goals. They like to learn in realistic contexts, can be extrinsically motivated, and like to learn by doing. (Hoekzema, 2008, p. 55)

More specific areas in which the teachers felt they became more professional were also mentioned, indicating gains in PCK and general pedagogical knowledge, such as becoming more skilled in applying specific instructional approaches for specific topics, becoming better at bridging the gap between physics and chemistry topics, gaining insight into how to realize truly adaptive learner-centred learning environments, and improved fine-tuning between primary and secondary education in some domain.

Effects on Curriculum Enactment

Most of the articles provided information about how the materials worked in practice. Teachers as well as students were quoted to illustrate typical aspects of successes and failures of the designs, such as student motivation, learning outcomes, and essential learning processes that were observed. For the teachers, student motivation and learning outcomes were by far the most important measures of the design's success. The enactment of the designed product was mostly followed anecdotally. The articles were heavily laden with anecdotes and they cited both teacher and student experiences with the new materials.

Our colloquial data also included indications of positive effects of professional development on the quality and sustainability of curriculum innovation. First of all, some design teams involved all teachers from the school or the department, resulting in a school- or department-wide process of redesigning. The shared ownership and fine-tuning between each other's experiences, attitudes and visions seemed firm and continuous, and implied that the curriculum innovation had become embedded within the school's vision. Sustainable team-wide discussion and collaborative (re) design became more appropriate. For instance, one study concluded: "The curriculum innovation has not finished yet. But the interrelatedness between different renewal processes has become more clear to the teachers, and less than before, the teachers experience the innovations as 'again we must change' " (Koelemij & Visser-Meijman, 2007, p. 34). Another article said: "The design team has found some new young members. Together with 'the oldies' we seem to have reached a good mix to keep contributing to the mathematics curriculum of the future" (Van den Broek, 2007, p. 19). Furthermore, forming a design team opened the way to invite external participants. The input that came from domain experts and teacher colleagues from other schools seemed, in some cases, to result in a more structured design process, and opportunities to translate experiences from others to one's own school setting. For instance, one expert introduced video-stimulated recall to collaboratively observe the effects of a new instructional approach in the classroom. This helped members of the design team get a better grip on the effects on their curriculum, and hence made it easier to make further adjustments (Koelemij & Visser-Meijman, 2007).

Results: The Scientific Corpus

The scientific corpus showed that teacher design teams were not (yet) a major focus in empirical educational research. Nine small-scale studies and one large-scale study (Parchmann et al., 2006) were selected (Table 3.3). Similar to the professional articles, most studies ($n = 8$) pertained to primary and secondary education. The majority of the teams aimed to design a lesson series within the domain of science, technology or mathematics. In most cases researchers and/or intermediates from consultancy offices took the initiative ($n = 7$).

Characteristics of the Design Teams

Similar to the colloquial corpus, the scientific corpus pertained to design teams that were either school-based ($n = 5$), or regionally/nationally organized, having members from different schools ($n = 4$). The size of the teams varied from 2 up to 18 participants. A notable difference with the colloquial corpus was that the initiative for the project was mostly taken by others than the teachers ($n = 6$, 1 unclear). Teachers often had the role of learners, while researchers took the role of facilitator of the design processes. The image that emerged from these studies was that researchers and teachers tended to differ in aims and orientations, revealed by application of different criteria for assessing quality of processes and products. Some studies approached these discrepancies as differences in aims and orientations

Table 3.3 Summaries of the scientific projects

Study	Summary of the project
Baildon and Damico (2008)	A team of six humanities teachers at an American international school in Singapore refined and tested a tool for literacy and inquiry lessons during 1 year. The initial tool was developed by one of the participating teachers. The common aim of the group was to improve their inquiry lessons and develop a broad view on inquiry
Deketelaere and Kelchtermans (1996)	A team of 17 Belgian teachers from different subject areas and an educational researcher co-designed two modules from scratch that aimed at 'breaking through gender roles and interesting girls in technology'. The researcher was initiator, guide and keeper of the process that covered problem analysis activities, design, try-out and evaluation/reflection activities over a 2-year time span
Fernandez (2005)	A team of four U.S. elementary teachers engaged in mathematics lesson study for 3 months. Teachers received schooling in the lesson study approach, after which they adapted an exemplary lesson on 'helping students see why fractions are needed to solve certain problems of sharing'. The researcher, who was initiator of the project, only interfered at the teachers' request
George and Lubben (2002)	Two teams of ten teachers from Trinidad and Tobago were selected for a 4-day workshop on learning to design context-based science education. The researchers led the workshop. After initial problem analysis, teachers co-designed context-based science lessons that were then evaluated by experts
Parchmann et al. (2006)	Teacher design teams (about ten participants each) were formed in Germany to design and implement context-based chemistry education according to a framework, over a 2-year timespan. Chemistry education researchers developed the framework in co-operation with 37 teachers. Chemistry education researchers guided the teams, providing them with the framework and exemplary materials
Rock and Wilson (2005)	Two teams of four elementary teachers in the U.S. each engaged in lesson study. The teams aimed at developing a teaching repertoire for differentiation in mathematics education and literacy, respectively. After initial training in the lesson study approach, teachers determined how to carry out the lesson study and what to talk about. Researchers only gave advice when asked
Schneider and Pickett (2006)	An engineer who taught at a university and a science teacher educator co-developed an engineering course for science education students (to be taught by the engineer) that was to be innovative in many ways *and* needed to meet the curriculum standards. One teacher taught the course. Evaluation findings were analysed and reported. The project took place in the U.S. over a period of 8 months
Shkedi (1996)	Eight teachers at a Jewish school in the U.S. participated in a 6-month school-based workshop that aimed at developing curriculum materials for teaching Jewish moral texts. The teachers discussed the materials and how they should be adapted for their teaching, under the guidance of a workshop leader
Voogt et al. (2005) -2nd study	The second study featured eight Russian physics teachers participating in workshops led by the researchers. The workshops aimed to support teachers with the implementation of technology-rich learner-centred approaches to learning physics, over a total timespan of 15 months. Teachers received training in basic technology skills and applications in physics and were introduced to learning centred approaches; based on problem analysis, they each designed teaching materials and shared their experiences with each other via a website

between researchers/intermediaries and teachers (cf. Deketelaere & Kelchtermans, 1996; Parchmann et al., 2006). In other studies, such discrepancies were taken to signify a lack of understanding on the teachers' part (George & Lubben, 2002).

Overall, the scientific corpus tended to emphasize the importance of a theoretical orientation and the need to think back and forth between classroom activities and design frameworks. The different orientations of researchers and teachers seemed to be more emotionally charged and problematic when the role of the teacher was less explicitly 'the learner' and more the equally equipped co-designer (Deketelaere & Kelchtermans, 1996).

Characteristics of the Design Process

In contrast to the colloquial corpus, the scientific data set gave far more detailed descriptions of the design and interaction processes in the teams. However, process characteristics were rarely if at all related to teacher development or curriculum enactment.

The design processes that emerged from the scientific data set differed distinctly from what was described by the colloquial corpus. First of all, none of the studies used teachers' motives to justify the project, except for Baildon and Damico (2008). Instead, arguments were used that encompassed evidence on what counts as good education and effective professional development. Secondly, all studies, except Schneider and Pickett (2006), emphasized the importance of different types of support for the process. None of the studies systematically analysed which support was effective in what way, however. Some types of support were mentioned by teachers when asked what they considered as helpful in the process (e.g., George & Lubben, 2002; Parchmann et al., 2006; Rock & Wilson, 2005). Some types were discussed by the researchers when reflecting on the process and findings (e.g., Baildon & Damico, 2008; Deketelaere & Kelchtermans, 1996; Fernandez, 2005; George & Lubben, 2002; Shkedi, 1996; Voogt et al., 2005). Across the studies, roughly three types of support emerged: pre-structuring of design activities; monitoring and directing discussions; and input of external expertise.

Thirdly, design activities were described as being highly pre-structured and explicitly planned. In systematic curriculum design, processes were typically iterative: problem analysis, design, enactment and evaluation, reflection, re-design and so on. All the studies were conducted within the conceptual framework of systematic curriculum design, although not all design teams went through the whole process, due to limited time and resources, and some studies only focused on one aspect of the design process in more detail, leaving it unclear precisely what other activities were performed. Two studies concerned 'lesson studies' (Fernandez, 2005; Rock & Wilson, 2005). In most cases, the lesson studies aimed at gaining insight into the learning processes of students within a specific domain by co-designing one lesson. The lesson was generally optimized in successive pre-structured cycles of enactment, evaluation, reflection and re-design. These teams were almost always guided by a domain and lesson study expert.

Fourth, in most studies ($n = 6$), the team was guided by someone who led the discussions, varying from a more procedural role (moderator) to a more directive role of instructor. When comparing different studies, it seemed that the less the process was actively directed and fed by an instructor, the more the boundaries of the innovation were determined by the boundaries of teacher knowledge, nicely illustrated in the articles by Shkedi (1996) and Deketelaere and Kelchtermans (1996). These studies elaborated on the types of discussions that emerged under the guidance of a workshop leader (Shkedi, 1996) and a member of the Flemish educational council (Deketelaere & Kelchtermans, 1996). Whereas the workshop leader tended to let discussions emerge from the concerns of the teachers and focused primarily on making sure that everyone had a say, the member of the Flemish educational council played an important directive role in creating a shared platform and directing discussions beyond the teachers' practical concerns to a more abstract level. In this latter study (Deketelaere & Kelchtermans, 1996), the participating teachers broadened their task perception and they became aware of the subjective and contextualised nature of their interpretive framework. In contrast, Shkedi (1996) concluded that discussions did not rise beyond the dilemmas that the teachers raised.

As in the colloquial corpus, external input provided support to teams: exemplary curriculum materials and explicit knowledge/skills. However, none of the articles reported a systematic study on the impact of external knowledge on the quality of processes and products. In several studies ($n = 7$), exemplary curriculum materials served as a means for stirring up discussions, explicating understandings (Baildon & Damico, 2008; Fernandez, 2005; George & Lubben, 2002; Shkedi, 1996; Voogt et al., 2005) and creating a shared vision (Deketelaere & Kelchtermans, 1996). Parchmann et al. (2006) mentioned that teachers indicated that they experienced exemplary materials as fostering the design process. In a few studies ($n = 4$), teachers were trained before they started designing. For example, in the studies by George and Lubben (2002) and Voogt et al. (2005), teachers participated in workshops on teaching approaches they were to implement in their designs; similarly, in the research by Fernandez (2005) and Rock and Wilson (2005), teachers were prepared for the lesson-study approach. In the research reported by Rock and Wilson (2005), teachers additionally invited experts to provide workshops in the areas they wanted to focus their lesson study on. They experienced the external input from experts as very beneficial to the process and related it directly to the problem being studied, which indicated active use of external knowledge. These findings strengthen the idea that fine-tuning the input of external knowledge and expertise to the needs of teachers is important.

Effects on Teachers' Professional Development

Most studies ($n = 8$) analysed the effects on professional development and measured a modest positive learning effect. Negative effects were also reported ($n = 3$). The effects on professional development differed in terms of content, width and depth both across and within studies. Several studies ($n = 4$) reported that teachers experienced some sort of professional growth in terms of broadened task perception, increased job satisfaction and/or feelings of empowerment and professional confidence.

Measurements of gains in knowledge were either rather fragmented and domain-specific or very general and elusive ('teachers felt they learned a lot'). The *quality* of the knowledge developed seemed especially difficult to capture. Precise conceptual definitions of teacher knowledge and teacher learning were generally lacking (cf Van Veen et al., 2010), as were logical operational definitions of such conceptualisations as measurable indicators (cf. Abell, 2008). General findings such as, "The teaching materials enhanced dialogue between the teachers that resulted in re-conceptualizing the nature of inquiry, re-considering their perspectives on subject matter understanding and in developing new views on the nature of end products" (Baildon & Damico, 2008), typically revealed meanings perceived differently at a more detailed level by each participant. Teachers developed different views of what constituted appropriate student end products.

Effects on Curriculum Enactment

Characteristics of actual curriculum enactment were only partially presented in some studies as indicators of teacher development (previous section). Only in Parchmann et al. (2006) was enactment measured by means of interviews and teacher questionnaires. In this project, collaborative design was used as an implementation furthering strategy. Many design teams were established to scale-up the innovation. The interviews and questionnaires revealed that not all design principles were equally implemented. Teachers used real-life contexts and developed student-oriented teaching methods, but they implemented the idea of developing concepts from the real-life contexts to a far lesser extent. Teachers feared that students would not learn appropriate subject- matter content well enough when contexts were used as a guideline for introducing concepts (Parchmann et al., 2006).

Conclusion

Two distinct pictures of design teams emerge from the two data sets (summarized in Table 3.4).

In the scientific corpus, projects aimed at developing curriculum materials using a conceptual framework that envisioned a new teaching approach. Teachers generally did not initiate the projects. Ironically, design teams were mostly viewed as a bottom-up strategy for essentially top-down innovations. Much attention was paid to the design process. Reported effects on teacher development were either general and elusive or fragmented. Quality and enactment of the new curricula were not studied systematically. Two related themes emerged that seem to point to possible critical factors:

- The roles that participants take. In most cases, teachers are explicitly learners.
- The extent to which teams are supported and directed. Directive external support for teachers seems needed to broaden their personal perspective.

In the colloquial corpus, teachers took the initiative for projects, addressing what they felt as acute, always concrete, problems. Teachers' feeling of ownership over the designs was greatly emphasized. Teams worked iteratively, although – so it seemed - unsystematically. Therefore, it was difficult to attribute effects to specific process characteristics. Effects on curriculum reform and professional development were highly visible in reported learning and motivational effects for students, and team and vision development effects amongst teachers.

Table 3.4 Summary of scientific and colloquial data sets

	Colloquial corpus	Scientific corpus
Team characteristics	Teacher-led	Researcher-led
	Teachers as experts	Teachers as learners
Process characteristics	Concern-driven	Theory-driven
	Cyclical	Systematic
	Incidental external input	Structural external support
Effects on teacher development	Experienced relevancy leading to ownership	Perceived relevancy leading to active involvement
	Team building	Elusive or fragmented and specific learning yields
Effects on curriculum enactment and attainment	From an ideal to an attained curriculum	From an ideal to a perceived curriculum

Discussion

New insights and societal developments continually ask for new, ambitious teaching practices. How to foster educational change through curriculum innovation has been a long-standing question within the worlds of educational research and innovation. It is rather commonly accepted nowadays that large-scale top-down approaches have little impact. Hence, the need arises to engage teachers as co-designers of new curricular materials in collaborative design settings (Handelzalts, 2009; Penuel, Fishman, Yamaguchi, & Gallagher, 2007). In this study we explored the scientific and colloquial evidence in order to gain insight into the conditions under which such teacher design teams are effective. We looked at the perspectives of researchers (scientific evidence) and of teachers (colloquial evidence) regarding what those conditions might look like. Obviously, the yield of relevant scientific articles was low. This might be due to publication bias. For this particular study, we were interested in empirical studies that examined processes. Such studies tend to be qualitative and complex and are generally more difficult to publish than quantitative effect studies. Furthermore, this study is unique in including colloquial reports. In order to draw conclusions about the added value of including colloquial evidence, we need to consider the differences between the data sets. First, there is an asymmetry of period and place for the two corpora of reports that is difficult to avoid due to practical reasons, as we pointed out previously. We think, however, that as there is no research agenda that directed responses, the colloquial corpus provides an unbiased picture of experiences of (in this case, Dutch) teachers participating in design teams within a certain time-span.

With the above in mind, roughly two different images emerged that seem to pertain to two models of curriculum change: teachers as learners who need to develop their knowledge and beliefs in order to adopt the change proposals of 'others' (mainly scientific evidence) and teachers as initiators and active agents of change (mainly colloquial evidence). The gap between change proposals and the competencies needed to implement the change proposals adequately (e.g., Kirschner, 2015), and actual teaching practices and teacher competencies is explicitly problematized. How teachers design their practices, what their goals are and what they are passionate or worried about, is mostly underexposed as a starting point for change. This 'gap' is not addressed as a problem in the colloquial evidence at all. However, in the colloquial corpus the conceptual foundations of the change are to some degree left unarticulated, as well as how the quality of the design process and the designs were preserved. The question that emerges is: did the scientific evidence and the colloquial evidence report on the same phenomena, but merely express different perspectives on what was important? Or did they actually report on teacher design teams that operated under different conditions? It seems prudent to pursue answers to questions such as these in subsequent research. Meanwhile, we conclude that although design teamwork is gaining momentum in practice, the research base from which guidance can be gleaned to inform future work needs to be strengthened.

References

Abell, S. K. (2008). Twenty years later: Does pedagogical content knowledge remain a useful idea? *International Journal of Science Education, 30*, 1405–1416.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher, 33*, 3–15.

Campbell, R., Pound, P., Pope, C., Britten, N., Pill, R., Morgan, M., et al. (2003). Evaluating meta-ethnography: A synthesis of qualitative research on lay experiences of diabetes and diabetes care. *Social Science and Medicine, 56*, 671–684.

Doyle, W., & Ponder, G. (1977). The practicality ethic in teacher decision-making. *Interchange, 8*, 1–12.

Handelzalts, A. (2009). *Collaborative curriculum development in teacher design teams*. Unpublished doctoral dissertation. Enschede, The Netherlands: University of Twente.

Kirschner, P. A. (2015). Do we need teachers as designers of technology enhanced learning? *Instructional Science, 43*(2), 309–322.

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94–102.

Lewis, C. (2000). *Lesson study: A handbook for teacher-led improvement of instruction*. Philadelphia: Research for Better Schools.

Lomas, J., Culyer, T., McCutcheon, C., McCauley, L., & Law, S. (2005). *Conceptualizing and combining evidence for health system guidance*. Ottawa, Canada: Canadian Health Services Research Foundation.

Lumpe, A. T. (2007). Research-based professional development: Teachers engaged in professional learning communities. *Journal of Science Teacher Education, 18*, 125–128.

Naidu, S., Anderson, J., & Riddle, M. (2000). The virtual print exhibition: A case of learning by designing. In R. Sims, M. O'Reilly, & S. Sawkins (Eds.), *Learning to choose: Choosing to learn (Short papers and works in progress)* (pp. 109–114). Lismore, Australia: Southern Cross University Press.

Noblit, G. W., & Hare, R. D. (1988). *Meta-ethnography: Synthesizing qualitative studies*. London: Sage Publications.

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.

Remillard, J. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research, 75*, 211–246.

Remillard, J. T., & Heck, D. J. (2014). Conceptualizing the curriculum enactment process in mathematics education. *ZDM Mathematics Education, 46*, 705–718. https://doi.org/10.1007/s11858-014-0600-4.

Severance, S., Penuel, W. R., Sumner, T., & Leary, H. (2016). Organizing for teacher agency in curricular co-design. *Journal of the Learning Sciences, 25*(4), 531–564.

Taba, H. (1962). *Curriculum development: Theory and practice*. New York: Harcourt, Brace & World.

Van Grieken, K., Dochy, F., Raes, E., & Kyndt, E. (2015). Teacher collaboration: A systematic review. *Educational Research Review, 15*, 17–40.

Van Veen, K., Zwart, R., Meirink, J., & Verloop, N. (2010). *Professionele ontwikkeling van leraren: Een reviewstudie (Professional development of teachers: A review study)*. Leiden, The Netherlands: ICLON.

Voogt, J. M., Laferrière, T., Breuleux, A., Itow, R. C., Hickey, D. T., & McKenney, S. E. (2015). Collaborative design as a form of professional development. *Instructional Science, 43*(2), 259–282. https://doi.org/10.1007/s11251-014-9340-7.

Voogt, J. M., Westbroek, H., Handelzalts, A., Walraven, A., McKenney, S. E., Pieters, J. M., & De Vries, B. (2011). Teacher learning in collaborative curriculum design. *Teaching and Teacher Education, 27*(8), 1235–1244.
Wenger, E. C., & Snyder, W. M. (2000). Communities of practice: The organizational frontier. *Harvard Business Review, 78*, 139–145.
Westbroek, H. B., Janssen, F. J. J. M., & Doyle, W. (2016). Perfectly reasonable in a particle world: Chemistry responses to a change proposal. *Research in Science Education, 46*, 1–21.

References of the Studies Included in the Review

Professional Papers

Baack, J. (2008). Praktische beoordelingsformulieren spreekvaardigheid. *Levende Talen Magazine, 8*, 13–16.
Boerstoel, F., & Wielaard, C. (2008). Dutch big picture van start. *Bij de les, 3*, 17–19.
Dijkstra, I. (2008). Gedifferentieerd onderwijs werkt: Oplossing voor leerling die groep 8 echt niet redt. *Didaktief, 1–2*, 46–48.
Heijn, J., & Kruger, J. (2008). Wiskunde in NLT. *Nieuwe Wiskrant, 1*, 10–14.
Hoekzema, J. (2008). Kiezen & kunnen: Dubbelvla op het Arentheem College. *Bij de les, 1*, 54–55.
Hollaardt, B. (2007). NLT: Een nieuw betavak dat grenzen overschrijdt. *Vernieuwing, 66*, 16–17.
Koelemij, G. J. E., & Visscher-Meijman, M. E. (2007). Invoering van het GIP-model op ZMLK-school de Ark. *Tijdschrift voor Orthopedagogiek, 46*, 27–37.
Oosterling, N. (2008). DisWis: Weer eens wat anders dan alleen afgeleiden en primitiveren. *Nieuwe Wiskrant, 28*, 24–28.
Van den Broek, L. (2007). Idealistische wiskundeleraren geven lesboek in eigen beheer uit. *Vernieuwing, 2*, 17–19.
Van der Westen, W. (2008a). 'Elke docent voor taalrendement!': Taalbeleid op het Rijswijks Lyceum deel 1. *Levende Talen Magazine, 1*, 9–12.
Van der Westen, W. (2008b). 'Elke docent voor taalrendement!': Taalbeleid op het Rijswijks Lyceum deel 2. *Levende Talen Magazine, 3*, 13–15.
Visser, M. (2008). Fast Lane English: Versterkt Engels op het Stella Maris College Meerssen. *Levende Talen Magazine, 5*, 17–20.

Scientific Papers

Baildon, M., & Damico, J. (2008). Negotiating epistemological challenges in thinking and practice: A case study of a literacy and inquiry tool as a mediator of professional conversation. *Teaching and Teacher Education, 24*, 1645–1657.
Deketelaere, A., & Kelchtermans, G. (1996). Collaborative curriculum development: An encounter of different professional knowledge systems. *Teachers and Teaching: Theory and Practice, 2*, 71–85.
Fernandez, C. (2005). Lesson study: A means for elementary teachers to develop the knowledge of mathematics needed for reform-minded teaching? *Mathematical Thinking and Learning, 7*, 265–289.
George, J. M., & Lubben, F. (2002). Facilitating teachers' professional growth through their involvement in creating context-based materials in science. *International Journal of Educational Development, 22*, 659–672.

Parchmann, I., Grasel, P. I., Baer, A., Nentwig, P., Demuth, R., & Ralle, B. (2006). Chemie im Kontext – a symbiotic implementation of a context-based teaching and learning approach. *International Journal of Science Education, 28*, 1041–1062.

Rock, T. C., & Wilson, C. (2005). Improving teaching through lesson study. *Teacher Education Quarterly, 32*, 77–92.

Schneider, R., & Pickett, M. (2006). Bridging engineering and science teaching: A collaborative effort to design instruction for college students. *School Science and Mathematics, 106*, 259–266.

Shkedi, A. (1996). School-based workshops for teacher participation in curriculum development. *Journal of Curriculum Studies, 28*, 699–711.

Voogt, J. M., Almekinders, M., Van den Akker, J. J. H., & Moonen, B. (2005). A blended in-service arrangement for classroom technology integration: Impacts on teachers and students. *Computers in Human Behavior, 21*, 523–539.