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CHAPTER 4

The interplay between practice-based research and school development through cross-professional collaboration in secondary education¹

Abstract

A recurrent discussion in the field of education is how to build linkages between educational research and school practice. Cross-professional collaboration between researchers and school practitioners can contribute to the interplay between practice-based research and school development. The aim of our study is to obtain a better understanding of how a productive interplay between practice-based research and school development is established in the context of research and development (R&D) projects in secondary education. Data from semi-structured interviews with professionals involved in the project, observations of project meetings, and document analysis were used. A productive interplay, in which practice-based research informed school development, was found in thirteen of the nineteen R&D projects. Important conditions in these thirteen projects include closing the feedback loop from research to school practice, and making clear agreements on communication and on division of roles and tasks.

Keywords: Interplay; practice-based research; school development; cross-professional collaboration; research and development projects

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Introduction

Academic researchers in education build upon existing knowledge and create new knowledge on various topics, for instance on students' learning and motivation, teachers' practice, curricula, school systems, educational policy; which in fact are all situated in education practice. Yet, a recurrent point of discussion is the weak alignment of educational research and school practice (McLaughlin & Black Hawkings, 2004). It is often stated that a strong linkage may contribute to improvements in educational practice (Hargreaves, 1999; Levin 2013; Vanderlinde & Van Braak, 2010). As Burkhardt and Schoenfeld (2003, p. 3) have observed, however, there is 'a lack of credible models of employing educational research to shape educational practice'.

Recently, several authors (e.g. Bronkhorst, Meijer, Koster, Akkerman, Vermunt, 2013; Levin, 2013; Ormel, Pareja Roblin, McKenney, Voogt, & Pieters, 2012; Penuel, Fishman, Cheng, & Sabelli, 2011) have made a plea for researchers and practitioners to collaboratively improve educational practice. Such collaboration is supposed to enhance the interplay between practice-based research and school development. However, it is not clear under what conditions practice-based research actually informs school practitioners to change their school practice.

In this paper we report on a multi-case study analysis of collaborative research and development (R&D) projects in schools. In these R&D projects, that were part of a funding scheme, practice-based research was performed in schools with the aim to inform school development. The R&D projects set the context for cross-professional collaboration between researchers and school practitioners. We refer to cross-professional collaboration as a process in which a diversity of professionals come together with divergent reasons to reach project goals via guiding, directing and performing research and development activities and through mutual communication (Penuel et al., 2011; Van de Ven, 2007; Wagner, 1997). In this paper we explore how a productive interplay between practice-based research and school development through cross-professional collaboration is established in R&D projects.

Practice-based research and school development

In the debate on the gap between research and practice, Gibbons et al. (1994), made a useful distinction between two types of knowledge development; called Mode I and Mode II. For both modes it is specified how linkages between research and practice can be understood. Mode I is characterised by linear linkages between the

academic field and school practice. Researchers have the responsibility to perform research and publish results in international journals, where after results are disseminated to practitioners who have the responsibility to read and use them. Mode I contributes to the debated gap between the academic field and school practice and leads to hierarchical relationships between academic researchers and practitioners. Mode II stimulates a stronger linkage between theory and practice. It encourages the emergence of communities of learning in which researchers and practitioners collaborate to create and use new knowledge. The knowledge transfer between both fields is thereby stimulated (Ormel et al., 2012; Nutley, Jung & Walter, 2008; Rynes, Bartunek & Daft, 2001). The collaboration model in Mode II yields other research questions, insights and solutions than Mode I does. The performance of practice-based research can be situated in Mode II. The aim of practice-based research is to generate useful knowledge on and for educational practice. Several types of research can be characterized as practice-based, for instance evaluation studies, effect studies or design research (McKenney & Reeves, 2013; McLaughlin & Black Hawkings, 2004). School practitioners are often more involved in this kind of research than in fundamental research. A significant feature of practice-based research is the specificity for the setting in which it is conducted. This specificity makes practice-based research to be of value for use, meaning that it can provide solutions to specific problems in school practice and support practitioners in their work (Broekkamp & Van Hout-Wolters, 2007; Earl & Katz, 2006; Coburn & Turner, 2012; Oancea & Furlong, 2007).

The process of performing practice-based research is often iterative, consisting of multiple cycles of problem analysis, implementation and evaluation. Particularly in design research interactive cycles of design, development, testing and evaluation are performed (Bauer & Fisher, 2007; McKenney & Reeves, 2013). School development refers to the activities in a school that aim at improving educational practices. These activities may range from alterations in teaching practice, to new forms of collaboration in teams, to changes in the structure and culture of the whole school organization (Massel, Goertz, & Barnes, 2012; Slegers & Leithwood, 2010; Walter, Nutley & Davies, 2005). The process of school development is typically iterative as well and involves several stages. It starts with a vision and a plan and is followed by the occurrence of changes in practice. Systematic evaluation of such changes, however, is uncommon (McLaughlin & Black Hawkings, 2004; Slegers & Leithwood, 2010).

A striking resemblance in the described processes of practice-based research and school development is the iterative element (see e.g. Bauer & Fisher, 2007). When practice-based research and school development come together, the term *interplay* can be used. *Interplay* between practice-based research and school

development can be described as a continuing process, in which the created knowledge from practice-based research provides a better understanding of school practice and strengthens school development, and in which school development is in turn a source for knowledge creation (Burkhardt, 2006; Levin, 2004). In this study we will concentrate on the impact of research on school development. Such interplay can be called productive in situations in which research is actually used to inform school development. For interplay to be productive, certain conditions are important. One condition mentioned in literature is a rhythm in which the stages of research and development are aligned (Bauer & Fisher, 2007; Baumfield & Butterworth, 2007). A critical aspect of rhythm is timeliness; research is for example timely when results become available at a moment when they are needed to take practical decisions in schools (Oancea & Furlong, 2007).

As practice-based research can consist of multiple cycles, there are several opportunities for feedback from research to school practice (Clow, 2012; Grimpe, Hartswood & Jirotko, 2014). It has been argued that academic knowledge can be integrated by practitioners in practical knowledge, thus providing them with a guideline for further actions to improve practice (McLaughlin & Black Hawkings, 2004; Vanderlinde & Van Braak, 2010; Van de Ven, 2007). Also several studies show that through collaboration with researchers, practitioners are encouraged to integrate research knowledge into their contextual and local understanding of practice (Cooper, Levin, & Campbell, 2009; Edwards 2012; Janssen, Westbroek, Doyle & Van Driel, 2013). However, little insight exists in how research knowledge is actually used in schools (Pareja Roblin, Ormel, McKenney, Voogt, & Pieters, 2014).

Cross-professional collaboration

Important aims of close collaborations between school practitioners and researchers are creating knowledge on school practice and improving school practice. A possible context for such collaboration is in R&D projects in education. Professionals in R&D projects are on the one hand school practitioners, i.e. school leaders and teachers, and on the other hand researchers, advisers and supervisors working at research and advice institutes. In an earlier study we introduced the term cross-professional collaboration (Schenke, Van Driel, Geijssels, Sligte, & Volman, in press), and characterized it by using the following dimensions: reasons to collaborate, division of tasks and roles, and communication (idem., in press). School practitioners participate in R&D projects in their school because they want to diagnose, understand and/or solve practical problems in their school, use

research to evaluate an innovation, and to share their practice oriented knowledge and insights with colleagues inside and outside their schools. Researchers have a need to understand practice, deepen their insights, and create new knowledge by being involved in (innovative) practice, and connect situated knowledge, school data and research results to knowledge derived from literature (Coburn & Stein, 2010; McKenney & Reeves, 2013; Ormel et al., 2012).

Collaboration of professionals with different backgrounds and with diverse goals, can encourage participants to learn from each other and each other's worlds. For instance, teachers can cross boundaries from educational practice to the academic field and become teacher researchers (Akkerman & Bakker, 2011; McLaughlin & Black Hawkings, 2004; Walter et al., 2005). When teacher researchers and school leaders use knowledge that is derived from a collaborative study this contributes to their own professional development. When they use such knowledge to change practical and conceptual elements in their school this can contribute to school development as well. At the same time researchers can learn from school practitioners while performing practice-based research, for example because they become aware of the complexity of schools and the sometimes limited relevance of general research findings for specific school practices (Cornelissen, Van Swet, Beijaard, & Bergen, 2013; Leeman & Wardekker, 2014; Rust, 2009; Walsh & Backe, 2013). Important conditions for mutual learning are receptiveness of the professionals towards each other's viewpoint and constant negotiation on the issues of research and school practice (Edwards, 2012; Oancea & Furlong, 2007). However, this does not necessarily mean that cross-professional collaboration contributes to school development as a matter of course. Such a contribution requires that the results of this collaboration, i.e. research results, are fed back into school practice.

This study

As researchers and practitioners move into closer collaboration and generate stronger linkages between them, it is important to understand how these professionals can shape a productive interplay between knowledge derived from practice-based research and changes occurring in school practice. The aim of this study is to obtain a better understanding of how a productive interplay between practice-based research and school development through cross-professional collaboration is established. In order to obtain a deeper insight in results, processes and conditions for this interplay we will examine R&D projects in Dutch secondary schools in which professionals collaboratively carried out research

and development activities. The R&D projects are part of a funding scheme that corresponds with a broader policy approach noticeable more often last decades in Europe and the United States, characterized by Crossley (2013) as an inside out approach. This bottom-up policy approach starts with asking schools to respond to a policy with clear accountability instead of a defined top-down policy. The inside out approach, in which the needs of schools are driving research goals, is intended to stimulate a greater input of practitioners in research. Examples of research in the context of R&D projects in schools are for instance monitoring an innovation aimed at the use of ICT in classrooms through student questionnaires; observing and evaluating lessons of teachers who changed their teaching methods; measuring students' learning when games are introduced in lessons.

Our research questions are:

1. *What types of changes occur in schools that are informed by practice-based research performed in R&D projects in secondary education?*
2. *How is feedback from practice-based research to school development organized?*
3. *Which conditions contribute to a productive interplay between practice-based research and school development?*

Method

The case studies

This study is set up according to a multi-case study design. In total nineteen R&D projects in secondary schools in the Netherlands were included in this study (Yin 2009). The authors of this article were engaged as overarching researchers and therefore were not involved in carrying out research in any of the projects. The projects received funding for research purposes for one, two or three years, after the funding application was accepted. The funding scheme of the Dutch Council for Secondary Education was intended for projects based on a question posed by a school, which fits in the inside out approach (Crossley, 2013). The school concerned had to apply for the funding and carried responsibility for the possible transfer of the research budget to a party with research expertise, i.e. universities, universities of applied sciences, teacher education institutes and research and advice bureaus. In every R&D project professionals developed and studied a program, course or intervention in school practice. For example a project, in which teachers designed digital material, implemented these in their lessons and researchers observed lessons and tested students' achievement levels. In another project teachers' pedagogical skills were trained and research results provided information on changes in their classroom behavior. The studies performed in the projects can be

defined as practice-based research, as researchers and practitioners were primarily concerned with examining questions and problems situated in the school. The aims of the funding organization were that the research would contribute to school development and would yield knowledge that could be shared in the education field. In this paper we will concentrate on the first aim. The paper covers the entire three years of the funding scheme.

Participants in the study

In the R&D projects different professionals were involved: school leaders, teachers, and researchers, advisers, and supervisors. These professionals were the participants in this study. (Advisers provided school leaders with advise on research and school issues. Supervisors were coaches for teachers who were developing lesson materials and/or performing research in school.) We conducted interviews in four rounds; at the start of the project (round 1), end of the first year (round 2), the end of the second year (round 3) and at the end of the third year of the projects (round 4) when the funding of the projects finished. We interviewed twenty-eight school leaders and teachers who functioned as project manager in their schools, and twenty-three researchers, advisers, and supervisors from educational institutes. In most schools the same professionals were involved in every round, but in one school we interviewed another project manager in round two and three. In three projects other researchers got involved during the process. Extra information on the role of school leaders and of teacher researchers in the projects was acquired by interviewing eight school leaders in the first and final year of the projects, and nine teacher researchers who collected and analyzed data in their school in the third round of interviews.

Data collection

Data for this study were collected through document analysis, semi-structured interviews, and observation of meetings. The documentation concerned project applications, progress reports by project managers and final research reports, and reports of small conferences in which experiences were shared between professionals of different projects. The purpose of collecting these documents was to use them as background information in the preparation of the interviews as well as in the analysis of the interviews.

All interviews with the professionals involved in the projects were based on pre-structured interview guidelines. These interview guidelines contained questions about the goals of the R&D project, the progress made in the project, the practice-based research (research goals, type of research, the created knowledge), the occurrence of changes in school (i.e. school development), vision of the

participants on practice-based research and school development, and about cross-professional collaboration among the professionals in the projects (reasons for collaboration, division of roles and tasks, communication, and perceived successes and barriers). The first author of this paper carried out observations of meetings in which professionals shared research results within the project team and meetings in which school colleagues were informed about the progress and results of the projects. The primary aim of the observations was to get more insight in how feedback of research knowledge was organized.

Data analysis

The analysis of the data was performed in four phases. At the start of the first phase we operationalized the main elements of this study, as follows:

- Relevant aspects for characterizing the practice-based research were distinguished: type of research, domain on which the research focuses, research results and knowledge derived from the research.
- School development is seen in this study as a continuous process aimed at improving practices in school. School leaders, teachers, researchers, advisers and supervisors may be involved in school development activities. School development can become visible in actual changes in school practices. In our analysis we focused on changes that directly resulted from activities conducted in the R&D projects and did not examine indirect changes that may have occurred in the wider school organization stemming from the R&D projects. We made a distinction between conceptual changes, i.e. changes in how certain aspects of school practice are understood, and practical changes in school practice, i.e. concrete, visible changes (see e.g., Massel et al., 2012; Walter et al., 2005).
- The interplay between practice-based research and school development is described in this study as a continuing process, in which the created knowledge from practice-based research provides a better understanding of school practice and strengthens school development.
- A productive interplay is referred to as a situation in which practice-based research performed in the R&D project actually informs school development.
- Cross-professional collaboration among professionals in the project is examined in terms of three dimensions: reasons for collaboration, division of roles and tasks, and communication among professionals. The first dimension - reasons for collaboration - is characterized in terms of whether there is congruency in the professionals' reasons to collaborate or that the researchers have additional goals (for example commercial interests). The second dimension - division of roles and tasks - is examined by characterizing the role of each professional in the project. The third dimension - communication - is operationalized by focusing

on meetings and time investment. We decided to make a distinction between three ways of organizing communication in the project: two or three times a year a meeting; monthly meetings; and weekly meetings in which teachers, school leaders and researchers, advisers, and supervisors collaborated.

- Conditions for a productive interplay were derived from information about successes and barriers in communication, and division of roles and tasks, as mentioned in interviews and research reports.

In the first phase of data analysis we started with studying the final research reports and progress reports of all nineteen projects. We considered the research results per project, which provided the first insights in the knowledge created in the projects, and the changes in the schools that were described, which provided insights in school development. Then we developed a coding scheme based on the literature and our research questions, see Appendix A. We used MaxQDA (version 10) for coding the interview fragments and organized the results in a matrix. Also our understandings of observations of project meetings and the document analysis were included. The outcome of the first phase was a cross-site matrix in which all information on practice-based research, school development and cross-professional collaboration per project was collected. In the rows of the matrix we entered the nineteen project codes and in the columns we entered the corresponding information of each project (Miles & Huberman, 1994). For more information on characteristics of cross-professional collaboration in the R&D projects, we refer to Appendix B.

The next phases were aimed at answering the research questions. In the second phase of the analysis we closely examined the cross-site matrix with a focus on whether or not practical and conceptual changes in school were informed by practice-based research (research question 1). The results of this phase made it possible to characterize projects as showing a productive interplay or a less productive interplay between practice-based research and school development.

The third phase of data analysis consisted of analyzing all projects by concentrating on cycles of research and development activities that were observable in the projects. We focused on how research was feeded back to inform school development (research question 2). This happened mostly by presentations of research results or in meetings with professionals in the project. We examined characteristics of how feedback was provided, such as the frequency of providing feedback of research results, and we organized projects in a matrix to discover similarities and differences in feedback.

The fourth and final analysis provided insight in the conditions under which a productive interplay occurred (research question 3). We analyzed what

professionals mentioned as successes and barriers in communication and in division of roles and tasks in the projects. We related this information to the results of the second and third phase.

As a form of internal audit, the research team discussed all the steps in the process of analysis and its results, and where necessary the primary data were rechecked (Miles & Huberman, 1994). As a form of external audit a second researcher, who was not part of the research team, but familiar with the R&D projects, was asked to reconstruct the analysis, judge decisions made by the authors, and check the data that were included in a matrix. She specifically checked the characterization by the authors of the interplay in the projects as productive or less productive interplay and of the way in which feedback from research to practice was provided in each project. As an outcome of the dialogue with the second researcher we described more precisely when we characterized a project as showing a productive or less productive interplay, by concentrating on whether or not conceptual and practical changes in a school occurred with the use of research performed in the project.

Results

Role of practice-based research in occurrence of changes in school

In this first section, we will focus on the first research question: *What types of changes occur in schools, that are informed by practice-based research performed in R&D projects in secondary education?* A first finding is that in all nineteen R&D projects new knowledge was created by performing research. Knowledge concerned three domains: innovation, teachers' practice and quality of the school organization. In several projects, research and development activities focused on more than one domain. The first domain, innovation in school, mainly concerned the functioning of innovations and their impact on students' learning (students' behavior, motivation or achievement). The second domain, professional development of teachers, involved teachers' activities in classroom, results of participating in a training program, and the personal and professional changes of teachers during the project. The third domain, the school organization, was studied by focusing on the quality of the organization, such as evaluations of interventions on a broader school level.

In all domains all kinds of practice-based research were performed, in some cases more than one kind of research. In fourteen of the nineteen projects an evaluation study was conducted and in five projects design research was performed. In two

projects the professionals' goal was to design a new instrument and test the validity of the instrument with students' scores and in two other projects the research goal was to develop and test new instruments on teachers. In two projects an effect study was started, but in only one study the effect study was actually performed. In the other project it was decided to change the effect study into an evaluation study.

Table 1 shows all nineteen R&D projects that are included in this study. We ordered the projects into a category of thirteen projects with a productive interplay and a category of six projects with a less productive interplay between practice-based research and school development.

Productive interplay

In thirteen of the nineteen projects research results were actually used to inform school development: a productive interplay between practice-based research and school development. In these thirteen projects both practical and conceptual changes were noticed that were informed by practice-based research performed in the project. School leaders and teachers made decisions about changes in a program, training or innovation, based on information from for instance a literature study, research results, or data of questionnaires or interviews.

Practical changes in practice, which were informed by research, involved adjustments in elements of an innovation, course, training or program. A good example of practical changes informed by research can be found in Project H. In this project, teacher researchers analyzed the latest literature on teaching literacy and conducted an evaluation study of their lessons. By integrating academic knowledge and research results in their practical knowledge, these teachers were able to improve their lessons. They implemented new literacy approaches such as observational learning and a special approach for motivating boys to read fiction. Another example can be found in Project M in which the school leaders decided to open up a training program to more teachers, when interviews with students of the first group of teachers who followed the training program revealed a positive result for these students. In the training teachers learned techniques for providing feedback on the learning process of their students. It was launched to enhance students' grades and improve relationships between teachers and students. The project manager, in this case the school leader, based her decision to focus on feedback techniques in the higher classes on research as well:

Based upon a study on our exam protocol and the use of it [by teachers] ... we concluded that one of the most important instruments to enhance grades [of students], to increase the standard, to make better tests, is the use of feedback techniques in the classroom (Interview school leader, Project M).

She informed one of her new team leaders about the results of the research and recommended to stimulate teachers in his team to integrate feedback techniques in their classroom:

... based upon the results of the project we gave it a try in the higher classes. We have a new team leader who will start at that position next school year ... We recommended him to make use of the content evaluation of the exam protocol and of the results of the feedback cycle, to make arrangements [with the teachers] on outcomes next year (Interview school leader, Project M).

School development can be traced by practical changes, but also by detecting conceptual changes in practice. A noticeable conceptual change in practice in all thirteen projects was that professionals expressed a better understanding of the main issue in their project with the use of research. New knowledge was considered and adapted in their conception of the innovation, professional development program or school organization. The knowledge derived from research and the experiences and results that it provided offered school practitioners for instance arguments to consolidate an innovation. The school leader of Project S pointed out:

The difference with previous innovations in our school is that we connect research to an innovation these days. I consider that as the strength of this project. A former pitfall of ours was to constantly innovate which lead to reinventing the wheel over and over again. We did not consolidate adequately and best practices were lost. Nowadays, our school board expresses the need to examine innovations in our school (Interview school leader, Project S).

Less productive interplay

A less productive interplay between practice-based research and school development was detected in six of the nineteen projects (see Table 1). Although these six projects produced research results, school leaders and teachers did not use research to create a better understanding of school issues (i.e. conceptual changes) or to inform decisions on practical changes in school. The school practitioners in the six projects put effort in school development: they were stimulating innovations in school, professional development programs for teachers or changes at the organizational level. However, these efforts in school development were not aligned with research performed in the project. For instance in Project P school leaders invested time in improving their quality system for supporting students with special educational needs. The school leaders desired more extensive and

▼ **Table 1** | Interplay between practice-based research and school development in nineteen R&D projects in schools

Project code	Productive interplay between practice-based research and school development													Less productive interplay between practice-based research and school development							
	B	E	D	H	I	C	O	J	L	M	Q	S	R	A	N	A	N	F	G	K	P
School development and research	Practical and conceptual changes on three domains informed by research	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
	Innovation: students behavior, motivation or achievement																				
	Teachers' professional development	X	X	X	X	X	X	X	X	X	X	X	X								
	School organization: quality of organization							X	X	X											
Types of research	Design research	X			X	X	X	X													
	Evaluation research		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Effect research											X									
	Develop an instrument											X				X					X
Purpose of research	Congruent reasons of professionals	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Additional reasons of researcher											X	X	X							
Practitioners participation in research	Teacher researchers	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	School leaders, project managers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Communication	Weekly meetings	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Monthly meetings																				
	Two or three times a year a meeting																				

Note: X = as observed in the project; - = less changes in school occurred that were informed by research.

evidence-based information on their organizational quality system, but this was not congruent with the research goal the researchers had in mind.

Feedback in the R&D projects

In this section the second research question is answered: *How is feedback from practice-based research to school development organized?* Throughout the duration of the projects we have noticed several, iterative cycles of research and development, which each time provided possibilities for connections between practice-based research and school development. For example when research results were available, a presentation could be given to inform practitioners' decisions on school issues. After considering these cycles, we identified two kinds of feedback loops in the R&D projects: short-term feedback loops and long-term feedback loops. The feedback loops show no direct cohesion with a productive or less productive interplay. In twelve projects we observed short-term feedback loops that offered professionals new knowledge out of research several times during a year (see Table 1). Long-term feedback loops were observed in seven projects and contained the provision of feedback of research knowledge after the research itself was finished.

Short-term feedback loops

Short-term feedback loops, found in twelve projects, provided the opportunity for professionals to quickly adjust a program or intervention. In these projects an iterative process between research and development was observed: feedback of research results by researchers and teacher researchers was provided regularly during the school year. Professionals met each other in frequent meetings once a month, or even created a professional learning community in which they worked together in weekly meetings. The cross-professional collaboration in these projects is further characterized by congruent reasons for performing the research; professionals jointly agreed on the purpose of the research, which was derived from questions posed by the schools.

We will provide two examples of projects with short-term feedback loops. In Project B one of the school leaders initiated the use of mind maps to teachers. In close collaboration with other colleagues and a supervisor the school leader had initiated a monitor about the use of the mind maps in science and intended to perform an effect study on their use on students' science achievement. However, the project team decided to postpone certain components of the effect study and change it into an evaluation study that fitted better with the need of the school board and teachers who required research results during the school year. Consequently, instead of results on the effect of the innovation on students' achievement at the end

of the school year, they now had access to knowledge that came from test results in science and interviews with students during the year, and were challenged to alter elements of the innovation. The supervisor elaborated on this:

These results are very interesting and it absolutely provides us with strengths and weaknesses on how to introduce mind maps in school. Next year, the idea is to make use of shorter feedback loops, ... question students more often on what their opinion is on how it works. When it becomes clear to us that the program [on mind maps] is fully developed ... than the time is right to measure again in terms of students' achievement and motivation (Interview supervisor, Project B).

In Project D several interventions had been set up to create a smooth transition for students when they leave elementary school at the age of twelve and enter secondary school, situated in a larger school building with more students. One of the interventions aimed at teachers and their influence on student motivation and classroom climate. The researcher in this project constructed a questionnaire on these topics. The results were evaluated during a meeting with parents and teachers and also in smaller groups of teachers in the different participating schools. Two project managers who were school leaders in two different schools ran these meetings. One of the project managers reflected on the process:

Recently this questionnaire is filled in for the second time. In the first round we noted differences between the elementary schools and a difference between the elementary schools and secondary school regarding the options students have in their program. We draw some first conclusions with the goal to see in the second round of questionnaires if there is a change in the course of the year [concerning the classroom climate]. ... We do expect to see a dip in motivation when students go to secondary education (Interview school leader, Project D).

After the results of the second round in Project D were available, the project managers and teachers discussed the results and decided to pay more time and attention to the motivation of the students in the mentoring program. The short-term feedback loops in this project provided the project managers with new information during the school year. They not only used this information to check if their innovation was on the right track, but also used the data to encourage colleagues to change their practice in order to motivate their students.

A final notion in seven of the twelve projects containing short-term feedback loops was a growing research engagement of school practitioners. In Projects A, B, C, E, H, I, and J it became more common to ask critical questions on school

issues and for example discuss and evaluate innovations or existing programs by analyzing data.

Long-term feedback loops

In the seven projects with long-term feedback loops, professionals mostly met each other two or three times a year, with a prominent position for the final meeting of the year in which research results were presented. This meeting was in all cases with a larger group of school practitioners (for example all teachers teaching a certain grade or subject) and was meant for sharing research results. Professionals mentioned several elements that they considered important in communication, such as expressing expectations to each other, making agreements on tasks and schedule, and paying attention to both informal and digital communication means. In three of the seven projects the external researcher brought along additional reasons next to paying attention to school questions and school issues (see Table 1). These concerned collecting data for academic purposes or developing a literacy instrument for commercial reasons. The roles and tasks in these projects were more traditionally divided: researchers had the main responsibility for formulating research questions, and collecting and analyzing the data, while teachers and school leaders typically participated in this research as respondents.

An example of a project with a long-term feedback loop is Project R. In Project R teachers started with a training program on how to observe each other in lessons in order to improve their teaching skills. After observing colleagues in their lessons and filling in observation instruments, which were developed by the researchers, the results showed changes in the teachers' teaching practice. The presentation of the researcher at the end of the project showed the teachers these results and they were encouraged to keep working on improving their teaching skills.

Conditions for a productive interplay

In this final section we will answer the third research question: *Which conditions in R&D projects contribute to a productive interplay between practice-based research and school development?*

Conditions in projects with short-term feedback loops and a productive interplay

In ten out of the thirteen projects with a productive interplay, the projects contained short-term feedback loops.

A first condition in these projects was the ability of the professionals to respond adaptively to new research results. The school practitioners and researchers had timeliness in mind: research results became available at a moment when they were needed in school. Actually, these professionals were closing the feedback loop; the closing was mainly done by the school practitioners, but based on input of the researchers. In other words: in these ten projects the rhythms of practice-based research and school development were aligned. This is a main difference with the three projects that also contained short-term feedback loops, but had a less productive interplay. Project I is an example of a project in which professionals showed adaptive responses. The researcher involved in Project I expressed that she and the project manager learned from experiences and from the knowledge derived from research results in the first year. They decided to change parts of the program of the teacher training in the second year and to include school leaders as coaches in the project to increase their involvement with the teachers' development. The researcher explained how these adjustments were supposed to influence the teachers:

It will have an impact on how this teacher will feel supported by the school board. ... We have said we like this to be more structured next year. We also want to go back to two meetings every month on Wednesday. In one meeting we will put emphasis on peer supervision, by bringing together two teachers with two other teachers that work in a different school location. The school leader will function as their coach. So, the noncommittal atmosphere we had this year will disappear ... In the other meeting we will preserve the same character as it was this year, explicitly focused on sharing knowledge [between the teachers] (Interview researcher, Project I).

A second condition concerns the ability to tune in with other professionals. Tuning-in with other professionals may have been facilitated by the monthly or weekly meetings or the formation of a kind of professional learning community that was seen in several of these projects. Cross-professional collaboration provided the opportunity to extensively exchange ideas about practice-based research and school issues. For example in Project I, where the researcher had to fine-tune ideas and plans with the teachers and project manager during the first year. She stated:

Sometimes we had a disagreement on the content, we saw things differently. But actually we always resolved the arguments. It has to do with your background, your other vision, but not that it clashes (Interview researcher, Project I).

A third condition – to share and discuss knowledge and skills in the project – contributed to a better and deeper understanding of each other and the work of the other. This condition was found in projects with short-term feedback loops in which professionals invested a medium or high amount of time in the project. For instance in Project E in which the professionals showed changes in their understanding of the terminology they used in the project. They decided not to use the label of highly gifted students any longer, but focused on the term gifted students and their underachievement. When asked about his knowledge on gifted students after finishing literature study and having discussions on the core concepts in the project, the school leader explained:

Yes, it is like inside a ball from which you can pull out all kinds of strings. Concerning gifted students and their achievement, it has become an aspect of which we have a better insight in what is happening. ... However we are not there yet, I mean it is the start of a new beginning, but we sense this is an important result (Interview school leader, Project E).

He reflected on the process of sharing and discussing new knowledge, based upon a better understanding of literature:

It felt like a very interesting process, because, well it is not about highly gifted students and not about underachievement of students. Underachievement is not a very sharp defined term, therefore we had very nice discussions on this label, such as what are characteristics based upon literature and how should we compose the group [of gifted students]. We did a good job with combining the different characteristics we derived from literature (Interview school leader, Project E).

Conditions in projects with long-term feedback loops and a productive interplay

In three projects (Project Q, R and S) with long-term feedback loops, conditions were available that led to a productive interplay.

A first condition entails professionals who are making agreements for meetings and division of roles and tasks, right from the start of the project. These kinds of agreements were missing in the other projects with long-term feedback loops.

A second condition was the ability of these researchers to translate the research results to the practitioners. This was usually done in a presentation at the end of the school year and can be seen as a way of closing the feedback loop. In Project R and S the researchers presented the results, including tables

in which the data was shown. This condition was also observed in Project Q, but it differs, because the translation of research results to school practitioners was done by one of the school leaders. In this project a central aim was to obtain insight in the functioning of the instrument for testing students' achievement in reading. The school leader had a background as a mathematician and was able to read the complex data correctly, which provided him and his colleagues with new insights:

Well, a part of the interpretation is of course written down in the report and there are also drawn some conclusions. But we have simply spoken on what we see that is happening between our weakest students and better students. We have observed that a gymnasium-student in general performs a little less high than an athenaeum-student in the subject of reading texts. And if we dig in deeper into the results, than it becomes clear that we have a lot of students on gymnasium-level who perform less than they could (Interview school leader, Project Q).

A third condition in these three projects was found on the side of the school practitioners. They had a vital task in interpreting the data and knowledge that was derived from research performed in the project and connecting these to their own school practice. The school leader assisted his colleagues in the interpretation of the research results. In the three projects this resulted primarily in practical changes in school. For instance, in Project Q, a practical change concerned introducing a more suitable text as part of a new version of the literacy instrument. They also made decisions on the basis of the data that came from the research, for instance to integrate special reading lessons into the weekly curriculum and to continue measuring the improvement in literacy after the project was finished by using the instrument developed in the project.

Conclusion and discussion

In this study we explored how a productive interplay between practice-based research and school development through cross-professional collaboration is established in R&D projects. Case-studies of nineteen R&D projects were performed. Firstly, we determined the characteristics of the practice-based research that was carried out in the projects and which practical and conceptual changes occurred in school practice. Research appeared to be focused on three domains: an innovation in the school, teachers' professional development, and the school organization as a whole. Professionals in thirteen of the nineteen

projects used knowledge derived from research performed in the project to inform practical and conceptual changes in school practice. School development was thereby approached in terms of changes occurring in school that directly were resulting from activities conducted in the R&D projects. Practical changes in schools involved alterations in aspects of an innovation, course or program. Conceptual changes concerned a better understanding of the professionals of the issues on which research was conducted.

Secondly, we examined how feedback from practice-based research to school development was organized in the projects. We distinguished between short-term and long-term feedback loops. Short-term feedback loops occurred when professionals met each other in frequent meetings. Such feedback loops encouraged professionals to quickly adjust a program or intervention in school via an iterative process of practice-based research and school development. Long-term feedback loops occurred when professionals involved in the project met each other two or three times a year. We found that in these projects the end meeting of the year was a prominent element in closing the feedback loop.

Finally, we focused on the conditions contributing to a productive interplay between practice-based research and school development, which was the case in thirteen projects. In the ten projects with a productive interplay and short-term feedback loops the professionals had frequent meetings. This encouraged the emergence of a professional learning community of which the professionals from both school practice and academic field were part. Professionals in these projects succeeded to tune in to other professionals and respond adaptively to research knowledge. The rhythms of practice-based research and school development were aligned. In the three projects with long-term feedback loops and a productive interplay, it proved important for professionals to translate and interpret research results, and make arrangements on meetings and division of roles and tasks.

The results of our study lead to the conclusion that R&D projects provided conditions for professionals to create an iterative process, in which knowledge from research was often used to inform decisions about school practice during the school year. These findings match with the so-called loop script which Bauer and Fisher (2007) presented, in which 'research draws its inspiration from practice and feeds the results back' (idem., p. 228). The rhythm of practice-based research coincided with the rhythm of school development, due to researchers and school practitioners who were aware of the importance of timeliness and were able to translate practice-based research to school practice. Oancea and Furlong (2007) mentioned these as important features of practice-based research.

The results of this study contribute to the literature on data use in schools. As Coburn and Turner (2012, p. 99) pointed out 'we still have shockingly little research on what happens when individuals interact with data in their workplace settings'. School leaders and teachers in thirteen of these nineteen R&D projects appeared to generate a better understanding of their practice with the insights they obtain by using research results. School leaders and teachers were particularly encouraged to take decisions informed by research performed in the projects in which practice-based research was finely attuned to school practice (Earl & Katz, 2006; Oancea & Furlong, 2007; Walter et al., 2005). Our study also provides insights in how future collaboration between school practitioners and researchers, advisers, and supervisors can be shaped in R&D projects, for instance on the issues of providing feedback, arranging meetings, and sharing purposes of research (McLaughlin & Black Hawkings, 2004; Ormel et al., 2012; Nutley et al., 2008). Our results suggest a relationship between researchers and practitioners in which they obtain a better understanding of their own and each other's background and purposes of a research (Edwards, 2012; McLaughlin & Black Hawkings, 2004).

Limitations and suggestions for future research

A first limitation concerns the context of the study. The R&D projects were part of the same funding scheme, which aimed to encourage the exchange of knowledge between the academic field and school practice in the projects. This might have influenced the professionals to share more knowledge and in different ways, than might be the case in other settings in which researchers and practitioners collaborate. Future studies on the interplay between practice-based research and school development in other contexts than funded R&D projects, may clarify whether the same conditions prevail. Secondly, in this study we focused explicitly on changes that directly resulted from activities conducted in the R&D projects. By examining indirect changes that may have occurred in the wider school organization as a consequence of research and development activities, a more extensive view of how practice-based research can inform school development may be obtained. Thirdly, our analysis is limited in that we have emphasized the interplay as moving in one direction, namely from practice-based research to school development. Research into how the cycle of school development to research works out would be a relevant next step. A final limitation is that the study focuses on conditions within the project and in the collaboration between professionals. However, characteristics of schools and research institutes may also influence the interplay between practice-based research and school development. Some information on these

characteristics was provided in interviews and in reports, but in future studies on professionals in R&D projects it is relevant to integrate more questions concerning the conditions in the context of the projects.

Implications of this study

What are the implications of this study for school leaders, teachers, and for researchers, advisers, and supervisors? The way the R&D projects were set up provided the professionals an opportunity to collaboratively work on joint goals relevant for researchers as well as practitioners. Although characteristics of cross-professional collaboration among the professionals differed between the projects, in general, our results suggest that it is important for a productive interplay to be aware of closing the feedback loops between research and changes in the school. On the one hand closing the feedback loop requires researchers, advisers, and supervisors to deepen their insight in for example school plans and goals in order to acquire a good perspective of school issues. On the other hand closing the feedback loop requires teachers and school leaders to use and interpret research to inform their school practice and introduce practical and conceptual changes in their school, which in turn must be monitored and evaluated.

The results in this study may encourage policy makers in the field of education to choose an inside out approach (Crossley, 2013). Our results show that by facilitating R&D projects in secondary education, a path is laid out that enables cross-professional collaboration between school leaders, teachers, and researchers, advisers, and supervisors. Through research funding these professionals can meet each other more often and develop a better understanding of each other's purposes with research in school. In our study we have seen a high number of professionals in schools and educational institutes who grasped the opportunity to share new knowledge and research results on innovations, teaching practice, and organizational changes, and actually use research to inform school development. Closing the feedback loop from research to school practice, and making clear agreements on communication and on division of roles and tasks appeared to be important conditions.

Appendix A

Coding scheme for round 3 and 4, used for analyzing interviews

Code	Explanation
R&D project team	
Project team; development	Composition of project team on the issue of development: names and tasks of project participants
Project team; research	Composition of project team on the issue of research: names and tasks of project participants
Changes in project team	Changes in project team; expectations for next school year; ways of transferring knowledge to new project participants in case of changes in project team
Project activities and output	
Development activities	Progress in project activities on level of development and opinion on this issue; with attention to e.g. an innovation, professional development of teachers
Research activities	Progress in project activities on level of research and opinion on this issue; with attention to e.g. tests, questionnaires, analysis, and reports
Role of research in the project	Role of research in the project, for instance informing school development, and opinion on this issue
Output work floor	Output visible on the work floor for colleagues and students
Output organization	Output on the organizational level; new structures and routines
Ideological output	Output on ideological level; changes in thinking; what is learned
Reached goals	Goals reached for research and development
Embedding research in school	
Conditions	Conditions on personal, material, and financial level
Support in school	Support of employees for research and development project; creation of support
Internal knowledge dissemination	Internal knowledge dissemination and contribution to school development
External knowledge dissemination	External knowledge dissemination and contribution to accountability
Permanent place in school	Ways for ensuring research to obtain a permanent place in school organization
School leader's vision on research	
Vision on research, research engagement, performing research in school	Vision on research engagement, on who has to/can perform research in school: academic and/or school participants
Vision on research; goal and audience	Vision on practice-based research: enhancing academic knowledge and/or contributing to improvement of practice; audience for practice-based research (academic world and/or practice)
Vision of institute	Vision of school/institute on performing practice-based research in school; support on performing research
Cross-professional collaboration	
Reasons for collaboration in project	
Connection research institute-school	What connects research institute-school, e.g. research theme, previous history
Reasons for collaboration	Reasons for collaboration research institute-school in this project; interests of parties
Project goals	Project goals; research and development
Convergent or divergent reasons	Convergent or divergent reasons for collaboration and project goals; vision on development and research
Opinion on collaboration	Opinion on how collaboration research institute-school works out

▼ Appendix A | Continued

Division of roles and tasks in project

Role of school leader	Role, tasks, actions undertaken, and responsibilities of school leader in research and development
Role of project manager	Role, tasks, actions undertaken, and responsibilities of project manager in research and development
Role researcher/adviser/ supervisor	Role, tasks, actions undertaken, and responsibilities of researcher, adviser, supervisor in research and development
Role teacher (researcher)	Role, tasks, and responsibilities of teacher (researcher); training and time and space facilitations; capable of performing research

Communication structure in project

Workplace researcher	Frequency of working at school or at institute by researcher
Contact person	Contact person at school for researcher
Time investment	Time investment in project in hours per week/month
Communication means	Means of communication between research institute-school: consultation, e-mail, phone

Advancing and restrictive factors

Advancing factors	Factors that are seen as advancing success, concerning output, activities and conditions, and collaboration
Restrictive factors	Factors that are seen as restrictive for success, concerning output, activities and conditions, and collaboration

Plans and expectations

Continuation of school development	To what extent is school development, for instance an innovation or program, continued next school year? Plans and expectations
Continuation of research in school	To what extent is research in school, for instance research engagement, teacher research, continued next school year? Plans and expectations
Continuation of cross-professional collaboration	To what extent is cross-professional collaboration between research institute-school continued next school year? Plans and expectations

Appendix B

Characteristics of cross-professional collaboration in R&D projects

Project code	Reasons for collaboration	Division of roles and tasks and communication							
		Direction and guidance		Role in research and time investment					
		Development	Research	School leader	Time investment	Teacher researcher	Time investment	External party	Time investment
Projects ABCDFG	Congruent	School	School and external party	Project manager	High	Present	High	Project manager, researcher, supervisor	High, sometimes low
Projects HIJKLM	Congruent	School and external party	School and external party	Project manager	High	Present	High	Project manager, researcher, adviser, supervisor	High
Projects NOP	Congruent	School and external party	School and external party	Project manager	Low	Not present	Low	Project manager, researcher, adviser, supervisor	High
Projects QRS	Additional	School and external party	External party	Attune to development	Average	Present	Low to average	Project manager, researcher, adviser, supervisor	Average to high