Cambridge Journal of Education
Vol. 40, No. 2, June 2010, 161–181

Routledge
Taylor & Francis Group

Teacher learning and collaboration in innovative teams

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(*Received 20 April 2009; final version received 25 March 2010*)

In this study the relationship between teacher learning and collaboration in innovative teams was explored. A comparative case study was conducted in five temporary teams in secondary schools. Several quantitative and qualitative data collection methods were used to examine collaboration, teacher learning, and the context for learning and collaboration. In cross-site analysis two complementary patterns of teacher learning and collaboration were identified. Collaboration in all teams could be characterized as 'sharing'. However, sharing was further specified with regard to differences in the content and aims of sharing. Different types of sharing were related to teacher learning. The results give cause to rethink the nature of interdependence in collaboration, and the nature of the relationship between collaboration and learning. A practical result may be that collaboration in innovative, temporary, and voluntary teams could be a promising direction for teacher professional development.

Keywords: teacher collaboration; interdependency; alignment; teacher learning; teams

In recent years, teacher learning has become an important topic in educational research. This growing interest in teacher learning can be explained by the ongoing pressure for change in education. Educational reforms require both changes in teachers' ways of thinking about student learning and changes in their teaching practices. In this context of reform the need for continuous teacher professional development is stressed.

Teacher collaboration generally is regarded as a positive condition for teacher learning. Teachers report collaboration with colleagues as a powerful learning environment (Dunn & Shriner, 1999; Kwakman, 1999; Lohman, 2005). While collaborating, teachers can exchange ideas or experiences, develop and discuss new materials, get feedback from colleagues, and give each other moral support (Butler, Novak Lauscher, Jarvis-Selinger, & Beckingham, 2004; Johnson, 2003; Meirink, Meijer, & Verloop, 2007).

Teacher collaboration in the context of subject departments has a long tradition in secondary education. However, organization of teachers into departments is not sufficient in itself to ensure that these teachers will collaborate on instructional and pedagogical topics leading to innovative teacher learning. The learning potential of collaboration depends on the interdependency in the collaborative relationships (Little, 1990; Rosenholtz, 1989).

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ISSN 0305-764X print/ISSN 1469-3577 online

DOI: 10.1080/0305764X.2010.481256
http://www.informaworld.com

In this study, teacher collaboration and learning were studied in innovative teacher teams in Dutch secondary education in which teachers participated voluntarily. These teams were regarded as innovative as they operated in a national educational reform context. The collaboration in the teams was aimed at designing and experimenting with new teaching practices. To promote learning from diversity the composition of the teams was interdisciplinary. The general assumption in this study was that teacher collaboration in these teams would show high levels of interdependency, and would foster teacher learning with regard to instructional innovation in teaching and learning. Five teams in five secondary schools were studied in order to better understand how teacher collaboration emerges in teams and how this relates to group characteristics and teacher learning.

The reform context

In this study, collaboration and teacher learning were studied in the context of an educational reform in the upper grades of Dutch senior secondary education (15- to 18-year-old pupils) (Ministry of Education, Culture and Science, 2008). From other studies it is known that a successful reform is highly dependent on the central role and commitment of teachers (Clandinin & Connelly, 1992; Skilbeck, 1998). Teachers need to be engaged in the reform process since they have the knowledge of everyday practice and the actual needs of their students. The participation of teachers in reforms potentially improves the quality of teaching and will strengthen teacher professionalism (Skilbeck, 1998).

In the Dutch educational reform, teachers were encouraged to introduce a new pedagogy fostering students' active and self-regulated learning (ASL) into their classrooms (Bolhuis & Voeten, 2001; Imants & Van de Ven, in press; Rijlaarsdam & Cozijn, 2000; Simons, Van der Linden, & Duffy, 2000). The new pedagogy involved teachers becoming facilitators of students' learning processes and assisting them in developing their own strategies for learning. This pedagogical approach was assumed to improve students' transition to higher education. Traditionally, many first year students leave university during or after one year. In higher education students are supposed to be able to regulate their own learning. In secondary education, however, students have not been prepared for this level of autonomy in their own learning. The implementation in schools of this national reform was on a voluntary basis; schools could choose how and how much of this new pedagogy should be implemented. This reform was closely related to the introduction of a new national curriculum for the upper grades of senior secondary education. Implementation of the new national curriculum and related standards was obligatory for schools. The proposed new pedagogy had a major impact on schools and teachers, in part because they have been presented within the framework of the compulsory national curriculum (Imants & Van de Ven, in press). For many teachers the new pedagogy implied a new or unfamiliar way of thinking about student learning (Oolbekkink-Marchand, Van Driel, & Verloop, 2006). Because of this need for teachers to change their beliefs about teaching and learning in addition to making changes in their instructional practices, the reform context was deemed to be an appropriate context for examining teacher learning in teams.

Conceptual framework

The central assumption in this study was that teacher learning is affected by teacher collaboration. More specifically, the focus was on what and how teachers learn in the

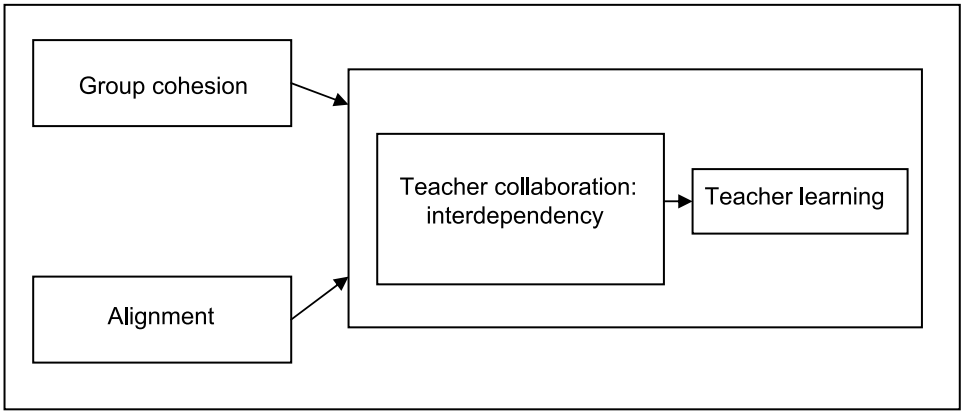

Figure 1. Teacher collaboration and learning in innovative teams.

context of an educational reform while they collaborate in teams in the context of specific group characteristics (Figure 1).

Teacher learning

The introduction of a new pedagogy required teachers to use a more student-oriented approach in their teaching practice. For a successful implementation of this new pedagogy to occur it was important that participating teachers changed their teaching behaviour, supported the underlying ideas of this pedagogy, and changed their educational beliefs.

Hammerness et al. (2005) distinguish two dimensions of teacher learning. The efficiency dimension involves 'greater abilities to perform certain tasks without having to devote too many attentional resources to achieve them' (p. 360). The innovative dimension aims at innovative teacher learning and requires teachers to give up old routines and change prior beliefs. In this study the focus was on teacher learning along the innovative dimension, and more specifically on changes in individual teachers' beliefs about teaching and learning (Bolhuis & Voeten, 2004; Van Driel, Bulte, & Verloop, 2007).

Comparable with the goal of fostering active and self-regulated *student* learning, we regard *teacher* learning as an ongoing process of engagement in activities that result in changes in teacher practices and changes in teacher beliefs regarding teaching and learning (see Putnam & Borko, 1997). Therefore, teachers' learning experiences with regard to implementing the new pedagogical approach were explored.

Teacher collaboration: interdependency

Teacher collaboration is a widely used concept. Notwithstanding the consensus on its important role in discussions on innovation and teacher learning in schools, collaboration is also a problematic concept. Collaboration has diverging meanings with regard to qualities of collaboration and learning outcomes. An illuminating distinction between cooperation and collaboration is made by Hord (1986). As opposed to collaboration, cooperation assumes two or more teachers, each with separate and autonomous

practices, who agree to work together to make their private practices more successful. In the terms used by Hammerness et al. (2005) this can be regarded as learning on the efficiency dimension. Collaboration implies that the teachers who are involved share responsibility and authority for making decisions about their common practices. In many schools teachers make efforts to cooperate, but it is much less common to find teachers actually collaborating. In daily practice, teachers and researchers often use the word collaboration while what they do, or study, is actually cooperation.

Although in the context of educational policy teacher autonomy varies from country to country, and from district to district, research shows that individual teachers' discretion and autonomy inside their classrooms in taking decisions about instruction and pedagogy for their own students, is generally high (Archbald & Porter, 1994). In consequence, the result of collaboration aimed at shared decision-making can be that teachers feel limited in their professional autonomy. This might help to explain why cooperation, with efficient division of tasks as its primary goal, occurs more often in subject departments and teams than collaboration which aims for improvement and professional development (Imants, Sleegers, & Witziers, 2001; Imants, 2003; Witziers, Sleegers, & Imants, 1999).

The concept of *interdependency* was considered to be relevant in examining processes and contents of collaboration in interdisciplinary teams. Little (1990) and Rosenholtz (1989) distinguish various types of collegiality and collaboration among teachers, based on the level of interdependence in interaction between teachers in everyday school practice. The hypothesis underlying these classifications is that in a group with a high level of interdependence, the teachers learn more than teachers in a group with a low level of interdependence. One type of collegial interaction with a low level of interdependence is labelled 'storytelling and scanning'. This type of collegial interaction, in which teachers learn about each others' teaching practice, often occurs in staff rooms or in hallways, and can be characterized best as moment-by-moment exchanges. The second type of collegial interaction with an intermediate level of interdependence is labelled 'aid and assistance'. It allows colleagues to critically look at one's teaching practice. The third type of collegial interaction is labeled 'sharing', or 'exchanging instructional materials and ideas'. In this type of collaboration teachers regularly share materials, methods, ideas, and opinions which allow them to make their daily teaching routines accessible to other teachers which promotes productive discussions of the curriculum. Finally, the type of collegial interaction with the highest level of interdependence is 'joint work' or 'instructional problem-solving and planning'. This type of interaction is assumed to hold a rich learning potential. In this type of collaboration teachers feel a collective responsibility for the work of teaching. They may either agree to act in a similar way in their own practice or agree on general principles that guide their individual actions in teaching practice. In the present study, Little's and Rosenholtz's classifications of types of collegial interaction were used to categorize collaboration in teams.

Alignment

According to Senge (1990), *alignment* in a team is essential to team learning. When a team becomes more aligned, a commonality in direction emerges, and individuals' energies harmonize. Team learning can be regarded as the process of alignment and developing the capacity of a team to produce the results its members truly desire. Following this conceptualization, alignment is a team characteristic that can be

assumed to develop in the teacher teams during the first year of the present study (Weick, 1979). Applied to the teams in this study, it can be expected that initially these teams were regarded by the participating teachers as common means to reach diverse individual goals, and that gradually these teachers would (or would not) develop common goals.

Alignment was explored by analysing two aspects of collaboration. Firstly, the extent to which the goals of the teachers were shared in the teams was analysed. Secondly, images of collaboration were looked for. These images represent prior experiences with collaboration in teams or groups. These experiences and images of working in teams determine teachers' expectations of collaboration in a new team (Homan, 2001). It was assumed that these initial images of collaboration of different team members gradually get in line with each other. The assumption was that high levels of alignment on both aspects were associated with interdependent relationships and innovative learning by team members.

Group cohesion

In the literature on group dynamics, *group cohesion* or *attraction to group* is considered to be related to the effectiveness of collaboration. Group cohesion can be defined as the 'glue' that holds a small group of people together, or the extent to which members of the group are attracted to each other. Cohesion is necessary for a group to be able to function (Evans & Jarvis, 1980; Evans & Jarvis, 1986; Pennington, 2002; Mebane & Galassi, 2003). The assumption is that a high level of group cohesion is associated with interdependent relationships and innovative learning by team members. High cohesive groups are generally more effective in achieving goals and solving problems than low cohesive groups (Shaw, 1981). However, high cohesion in a group may lead to groupthink (group members are no longer critical; they agree too much with other group members) (Little, 2003).

Method

In this study two research questions were addressed:

- How does teacher collaboration emerge in teams, and how is this collaboration related to group characteristics?
- How is teachers' collaboration in teams related to teacher learning in these team contexts?

The relation between collaboration and teacher learning was explored in teams that functioned within reform contexts. More specifically, these teams can be characterized as innovative, temporary and interdisciplinary, and participation in these teams is voluntary. These characteristics should be taken into account while analysing the collaboration and learning in these teams. For this reason we adopted a comparative case study methodology (Yin, 2003). This allowed us to apply several complementary methods for data collection, both quantitative and qualitative, and to validate data by triangulation. To triangulate the data and to answer the research questions, the focus in this study is on the systematic comparison of cases. This comparison starts from a replication logic: the same results (patterns in the data that were collected by several

independent instruments) are predicted in similar cases, while contrary patterns in results are predicted in diverging cases (Yin, 2003).

Participants

Five interdisciplinary teams in five different schools were selected for this study. In each team various subjects were represented (arts, science, and social sciences). In order to take account of the specific needs and concerns of teachers in each school, the teams were free to further specify the central topic of their collaboration, and to design their collaboration. Experienced coaches from the university assisted the teachers in establishing their collaboration in the interdisciplinary team. They paid explicit attention to the *process* of collaboration in the teams. As a guideline the coaches used a study team approach to monitor the process in collaboration (Tillema & Van der Westhuizen, 2006). A study team approach consists of three stages: (1) reflection; raising problem awareness by explicating knowledge and beliefs, (2) study; investigation, or enquiry using different perspectives, and (3) change; generation of conceptual artifacts (2006, pp. 54–55). These three stages are assumed to foster belief change.

Each team had (at least) five meetings during the school year that they participated in for this study. Teachers could use their time for professional development as set by national collective labour agreements for teachers to participate in the teams. In one school, meetings were facilitated by scheduling to ensure that all teachers were free from teaching responsibilities at the same time. Table 1 provides more information on the composition of the teams.

Data collection methods and initial data analysis

Collaboration

In describing the collaboration we focussed on interdependency. We explored *interdependency* by observing and recording field notes of the team meetings over a period of one school year in order to determine recurring interactions and topics. For Team A this implied observations and notes of seven meetings. Team B aimed to hold weekly meetings, in which in addition to the topic 'fostering active and self-regulated learning', problems with individual students would also be discussed. For this team only the meetings with a focus on 'active and self-regulated student learning' were observed. With Team C and E five meetings were observed, and with Team D six meetings were observed. These observations started from the *type of activities* that the teams undertook, such as storytelling, critical reflection, brainstorming, discussing, giving feedback, etc. The aim of these observations was to label the collaboration in the teams with a level of interdependency (Little, 1990). For example, teams in which teachers merely exchange experiences without critically examining these experiences show a lower level of interdependence compared to teams in which teachers regularly share experiences, ideas and methods and expect critical feedback from each other on their teaching practices.

Additionally, during the observations the *topics of the interaction* were also recorded, such as ideas for increasing student motivation, or explanations for a problem concerning depth in students' subject-matter mastery. The aim of these data was to differentiate between teams that succeeded in finding a shared problem or thinking up a shared project for their collaboration and teams that decided to focus their team meetings on teachers' individual problems. Teachers in teams with

Table 1. Team compositions.

	Teachers			Years of experience				School	
Team	Female	Male	Subjects	Mean	SD	Minimum	Maximum	Staff members	Students
A	4	3	Economics History Geography Science Physics Mathematics Chemistry	15.4	9.98	6	34	170	1600
B	5	3	Geography Science Dutch language English (3) Economics Physical education	20.8	9.96	7	33	80	800
C	3	1	Mathematics Economics Latin Culture and arts education	10.5	8.50	4	23	65	700
D	3	5	Biology English Culture and arts education Mathematics Economics (2) Dutch language (2)	15.0	4.60	10	25	90	950
E	3	4	Science Economics Physics English German Culture and arts education History	19.6	9.83	3	30	100	1000

a focus on a shared problem or project are more interdependent with regard to realizing their goals compared to teachers in teams with a focus on individual problems or projects.

The observations of types of activities and topics were summarized in five team descriptions. The descriptions of the team meetings were presented to one teacher from each team and to the coaches of the teams in order to make sure that these descriptions were adequate and valid observations of the team meetings. Finally, these team descriptions were classified into four types of collegiality/collaboration (Little, 1990; Rosenholtz, 1989). This classification was based on the type of activities that occurred most often in the team meetings, and the topics that best characterized the collaboration of each team in general. The label 'storytelling and scanning' was used to characterize teams in which teachers in the majority of the meetings merely exchange experiences with respect to individual problems with students or classes. Teams in which the majority of the meetings are about exchanging individual experiences, critically examining these experiences, and giving each other feedback were labelled as 'aid and assistance'. The label 'sharing' was used to characterize teams in which teachers regularly exchange both experiences and ideas and methods. The focus in such teams can be individual or shared problem solving. Finally, the label 'joint work' was used for teams with a focus on shared problem-solving and planning, which implies that teachers exchange experiences, ideas and methods aimed at developing shared innovative teaching practices.

Alignment

Teachers' perceptions of shared goals and teachers' images of collaboration were examined to explore *alignment* in the five teams. Data on teachers' perceptions of both aspects were collected using open-ended questions in a questionnaire addressing teachers' perceptions and evaluations of the collaboration in their team after a period of one school year. This questionnaire was completed by all teachers in the final meetings of their teams. Teachers were asked to describe their initial *images of the collaboration* in their team and to state whether the collaboration met these initial images. Also, the teachers were asked to describe the *shared goals* for the collaboration in their teams.

To determine the *alignment* in goals and images of collaboration in the five teams teacher written responses on the questionnaire were analysed. For each team we counted how often teachers indicated a friction in their *initial images* of the collaboration and the *actual collaboration*. Regarding *shared goals,* overlap in content of the reported goals in each team, for example using the words 'increasing student motivation', was determined.

Group cohesion

Information on *group cohesion* was collected using a Dutch translation of the Group Attitude Scale (Evans & Jarvis, 1986). The teachers responded to 20 items on a five-point Likert scale (1 = disagree to 5 = agree). Sample items include the following: (1) 'I want to remain a member of this group'; (3)'I look forward to coming to the group'; (12) 'In spite of individual differences, a feeling of unity exists in my group' (Appendix 1). The Group Attitude Scale was part of the evaluation questionnaire and was administered in or after the final meetings of the five

teams. Mean scores and standard deviations on the questionnaire were computed for each team.

Teacher learning

Teachers completed a questionnaire on beliefs about teaching and learning to obtain information on *what* they learned. In order to determine changes in their beliefs all teachers completed the questionnaire both at the beginning and at the end of the year in which they were studied.

The questionnaire consists of two related sets of scales: four scales on subject matter oriented beliefs and four analogous scales on student oriented beliefs (Table 2). It is assumed that high teacher scores on student oriented beliefs are congruent with the educational reform aimed at fostering active and self-regulated student learning. On the contrary, high scores on subject matter oriented beliefs are incongruent with the aims of the educational reform. Teachers scored all items of this questionnaire on a five-point scale (1 = totally disagree to 5 = totally agree). The reliabilities of seven scales were satisfactory. The *external affective regulation* scale showed a low reliability score. The items of this scale were omitted from further analysis.

To determine whether teachers changed their *beliefs about teaching and learning*, the mean scores on the seven scales were compared for the first and second time they completed the questionnaire. The Reliable Change Index (RCI) was used to determine significant differences (p <.05) in individual teacher scores on the seven scales (Jacobson & Truax, 1991). Significantly different scores on the seven scales were labelled as congruent or incongruent with the underlying aims and principles of the educational reform. Significantly lower scores on subject-matter-oriented beliefs, such as strong *teacher* regulation of students' learning processes, were labelled 'congruent with reform' as the reform aims at stronger *student* regulation of learning

Table 2. Questionnaire beliefs about teaching and learning.

Scales	
Subject matter oriented beliefs	Sample item
External cognitive regulation	It's important that the teacher makes sure that students know exactly how to work best on an assignment
External affective regulation	It's important that the teacher reassures students before they take a test
Reproduction of knowledge	Students learn better when they adopt the main and side issues from the teacher
Individual learning	Students learn better when they work individually on tasks
Student oriented beliefs	
Internal cognitive regulation	Students learn better when they have to check learning progress themselves
Internal affective regulation	Students learn better when they gain insight into their emotions
Construction of knowledge	It's important that the teacher allows students to relate the different aspects of the subject matter themselves
Collaborative learning	It's important that the teacher stimulates students to learn from each other

processes. Significantly higher scores on these subject matter beliefs were labelled 'incongruent with reform'. In the same way significantly lower scores on student-oriented beliefs were considered changes in beliefs 'incongruent with reform', and significantly higher scores on the student-oriented beliefs were labelled changes in beliefs 'congruent with reform'. For each team the number of significant congruent and incongruent changes in teacher beliefs was determined.

To explore *how* teachers learn in a context of collaboration in teams they were asked to report learning experiences in digital logs every six weeks. The aim of these digital logs was to give the teachers the opportunity to think carefully about meaningful learning experiences and write down all relevant aspects. For a comprehensive overview of how they learn teachers were asked to write down their learning experiences in a story-like manner, as a narrative in which they were asked to include and describe the cause, their thoughts, feelings, goals, and other persons. Furthermore, due to the reform context in which this study took place, the teachers were asked to report only those experiences related to the topic 'fostering active and self-regulated student learning' (Meirink et al., 2007). It was explained to the teachers that all learning experiences could be reported in their digital logs that they themselves considered to be relevant.

For the purpose of this specific study, the learning experiences reported in the digital logs were coded according to two categories. One category consisted of learning experiences in which teachers explicitly referred to the collaboration in the team as the context in which their learning experience took place (Category 1). The second category consisted of learning experiences with no explicit reference to the collaboration in the teams. The assumption underlying this analysis is that teachers who participated in effective teams would more often refer to the collaboration in their teams as the context in which their learning experiences occurred compared to teachers who participated in less effective teams. After carefully re-examining the learning experiences in the second category two new categories could be identified. Firstly, a category of learning experiences was identified, in which the theme of a learning experience corresponds with the theme of collaboration in the team, such as increasing student motivation (Category 2). This category was considered to be important compared to other categories as it provided information on how teachers implemented ideas from their collaboration in their teaching practices, and thus provides an indirect indication of the effectiveness of the collaboration in the teams on teacher learning. Secondly, a category was distinguished including learning experiences in which teachers reported learning as a result of collaboration with colleagues outside the team (Category 3). This category provided information on the frequency of other collegial interactions involving the participating teachers. The remaining learning experiences formed the fourth category.

Cross-site analysis

The systematic comparison of cases by matching patterns in the data included six steps. As a first step, a theoretically sound pattern of scores on the variables of the separate measures was derived from the theoretical framework as depicted in Figure 1. Secondly, the results of the teams on the various data collection instruments were summarized in an overview matrix (Appendix 2). The third step consisted of identifying one team from which the scores fit the theoretical pattern of teams with high learning scores. Fourthly, a complementary theoretically sound pattern was identified with relatively low learning scores. In the fifth step one site was identified in which the scores on all variables fitted well into the complementary pattern for teams

with low learning scores. In the sixth step of the cross-site analysis the match from all five cases with one of these two complementary patterns was determined.

Results

The aim of Step 1 in the cross-site analysis was to derive a theoretically sound pattern in the variables that were measured by diverging independent instruments. Pattern 1 in Table 3 represents a model which assumes that high scores on changes in beliefs (in Table 3 labelled as +) (*teacher learning*) and many learning experiences related to collaboration (in Table 3 labelled as +) (*teacher learning*) are associated with high frequencies in communicating ideas and discussing experiences of experimentation (+) (*interdependency*), high frequency of collective problem-solving (+) (*interdependency*), high *alignment* regarding goals and images of collaboration (+), and high perceived *group cohesion* (+).

In Step 2 the results of the teams on the various data collection instruments were summarized in an overview matrix (Appendix 2). In Step 3 one team was identified (Team A) from which the scores fitted well into the theoretical pattern of teams with high learning scores (Pattern 1, Table 3).

Team A

In the first meeting of this team the seven teachers exchanged their individual concerns with regard to their current teaching practices. It appeared that they all experienced problems with fostering self-regulated learning and were particularly concerned with how to stimulate student autonomy without losing depth in students' subject-matter mastery. After reaching the decision that this would be the topic for their collaboration, the coach of the team proposed to use an action-research related format to plan the collaborative process during the year. The teachers in this team were not really enthusiastic about this format and decided to spend their next meeting on thinking up ways

Table 3. Patterns in scores on the variables collaboration and teacher learning in innovative teams.

Variables	Pattern 1	Pattern 2
* Interdependency:		
Content of sharing		
- communicating ideas	+	+
- discussing experiences of experimentation	+	+/–
Aim of sharing		
- individual problem–solving	–	+
- collective problem–solving	+	+/–
* Alignment in:		
- goals	+	+/–
- images of collaboration	+	–
* Group cohesion	+	+/–
* Changes in beliefs	+	+/–
* Learning experiences related to collaboration	+	–

to plan their collaboration themselves. They started this second meeting with specifying the topic for their collaboration by making two lists: (1) things in their current teaching practices about which they are satisfied; (2) things in their current teaching practices which need improvement. With respect to the first list one of the teachers introduced his new idea for discussing test results with students in an alternative way. Essentially this idea encompassed students grading tests of other students instead of the usual procedure in which teachers discussed test results by means of whole-class instruction. The other teachers considered this to be a good method for stimulating self-regulated student learning, which additionally provided an opportunity for all teachers to approach students in a more positive, appreciative way. They argued that receiving positive attention would increase student motivation. They therefore agreed to think up more ways to discuss test results with students and experiment with these methods in their own practices. The team meetings would be used to exchange experiences and to critically discuss the results. In the end, their collaboration would result in a broad variety of methods that could be useful for other colleagues as well.

Based on the observations of the team meetings we found that the teachers in this team mainly exchanged ideas and discussed their experiences of experimentation with alternative teaching methods for discussing test results with students. The intended type of collaboration was labelled as 'joint work' as the aim of the team was to develop a variety of methods to discuss test results which they would all use. The actual collaboration however was labelled as 'sharing' as they did exchange experiences, ideas and methods aimed at shared problem solving in the majority of the meeting but they did not develop a joint method. The level of interdependency in this team can still be considered high, as the teachers in this team all had to contribute to the development of alternative methods for discussing test results with students in order to achieve their collective goal.

The teachers in this team could be regarded as successful in aligning their images of collaboration. The majority of the teachers evaluated their collaboration in this team in a positive manner. Moreover, they reported similar goals, like 'fostering and motivating students to learn in a self-regulated manner' and 'searching for and experimenting with ideas to foster students' self-motivation and independent work'.

The positive evaluation of the collaboration is clearly reflected in the high mean score on the Group Attitude Scale (a score of 4.15 on a five-point scale), and a low variability in scores between the teachers.

In line with the high level of interdependency, successful alignment of goals and images of collaboration, and positive evaluation of the team, a relatively high number of changes in beliefs about teaching and learning occurred in this team after the period of one year. Changes in beliefs both congruent and incongruent with the underlying ideas and principles of the reform were identified. Finally, in their digital logs, the teachers in this team often referred to the collaboration in their team as the context for their learning experiences, either with an explicit reference (21% of the total number of learning experiences) or with a corresponding topic, such as a description of a classroom experience with discussing test results with students (16%).

In Step 4 of the cross-site analysis a complementary pattern of scores on variables for teams with low learning scores was derived from the theoretical framework. Pattern 2 in Table 3 represents a model which assumes that mixed scores on changes in beliefs (labelled as +/– in Table 3) (*teacher learning*) and low scores on learning experiences related to collaboration (– in Table 3) (*teacher learning*) are associated with a high score on frequency in communicating ideas (+) but a mixed score on

frequency in discussing experiences of experimentation (+/–) (*interdependency*), a mixed score on frequency of collective problem-solving (+/–) (*interdependency*), a low or mixed score on *alignment* regarding goals and images of collaboration (– and +/–), and a mixed score on perceived *group cohesion* (+/–). In Step 5 a contrasting site was identified with relatively low learning scores (Team B), and the pattern of scores on all variables from the contrasting site was interpreted within the complementary theoretical pattern (Pattern 2).

Team B

The teachers in this team planned to hold weekly meetings aimed at collectively thinking up ways to deal with the whole school problem of the large number of students who had to repeat the fourth grade of senior general secondary education. The team discussed ways of motivating students in tutor lessons by making them more conscious of their own learning styles and by adapting their own teaching styles to students' learning styles. Also, problems with individual students were discussed during these meetings. All team meetings took place during regular teaching periods to facilitate successful collaboration.

The coach of this team stimulated the teachers to experiment with teaching methods that foster active student learning. However, in the majority of meetings, the eight teachers merely exchanged ideas or they spent much of the time discussing problems with students. Only two teachers actually experimented with alternative methods aimed at increasing active student learning in their own practices and discussed their experiences with these alternative methods in the team meetings. Although the collaboration in this team was labelled as 'sharing' due to the exchange of ideas and methods aimed at a shared problem, the actual collaboration in this team can be characterized as having a low level of interdependency within the category sharing, as the exchange of ideas for changing current teaching practices did not result in actual experimentation with alternative teaching methods.

Regarding alignment, the teachers on the team had mixed feelings. Four out of the eight teachers on this team reported friction between their initial images of the collaboration and the actual collaboration. One of the teachers reported that the discussions about changing teaching practices were often too theoretical, and that she had expected to discuss and exchange ideas that would be easily implemented in her daily teaching practice.

Also, the teachers gave mixed scores for cohesion in their team evaluations. These differences are clearly reflected in the high standard deviation on the Group Attraction Scale.

In line with previous results, the number of changes in beliefs about teaching and learning in this team was rather low. Only two of the eight teachers changed their beliefs in a way that was congruent with the aims of the reform. Changes in beliefs incongruent with the aims of the reform did not occur. Finally, the majority of the reported learning experiences were not related to either the collaboration or the topic of the collaboration in the team.

The result of the cross-site analysis so far is that two complementary theoretically sound patterns in the variables of this study were identified (Table 3). In Step 6 the match from all five cases (Appendix 2) with one of these two complementary patterns was determined. Part 1 of Appendix 2 shows that in all five teams the actual collaboration could be labelled as 'sharing'. Nevertheless, differences could be identified in

what exactly took place during the collaboration labelled 'sharing'. To differentiate the collaboration in the five teams, two subcategories were distinguished. The teams differed with respect to the content and aim of sharing. In some teams, the content of sharing was limited to *communicating ideas* for alternative methods. In other teams, *experiences* of experimenting with these alternative teaching methods *were discussed*, in connection with communicating these ideas. Moreover, in some teams, the aim was to solve the *problems of individual teachers*. In other teams, the aim was to solve instructional problems that were identified as *shared problems*.

Combining this differentiation in types of sharing with the results of the other data collection instruments showed the two patterns as presented in Table 3 to match with four out of the five teams. Team A and team E show the pattern with high learning scores. The pattern with low learning scores was mainly found in Team B and Team C. In both of these teams, the collaboration did not consist of exchanging ideas and experiences with experimentation aimed at shared instructional problem-solving, like in the other three teams. The Teams B and C, however, differ in the number of changed beliefs about teaching and learning. In Team B, only two of the eight participating teachers changed their beliefs, whereas in Team C two of the four participating teachers changed their beliefs in a way congruent with the aims of the reform.

As compared to the results of these four teams, the results of Team D seem to show an inconsistent pattern. To understand the results of this team it is important to take into account that the teachers in this team collaborated in dyads. Collaboration in these dyads differed considerably from collaboration in the whole team. In dyads the teachers agreed to observe each other during lessons and to critically reflect on these lessons. The team meetings consisted of sharing ideas and discussing experiences of experimentation with alternative methods aimed at shared instructional problem-solving. Teachers often reported similar goals with regard to the content of collaboration: increasing student motivation. However, much friction between initial images of collaboration and actual collaboration was reported. Unequal input of participants and too much discussion instead of brainstorming were reported as reasons for this friction. The teachers in this team were positive about the collaboration with their dyad partners during the school year. Brainstorming about ideas for alternative teaching methods and receiving feedback after lessons observed by the dyad partner were perceived as motivating and inspiring. Regarding teacher learning in this team, the results are in line with the results of Teams A and E. Many changes in beliefs about teaching and learning congruent with the aims of the reform occurred in this team. Also, the teachers often referred to the collaboration in their digital logs. However, these references to the collaboration were mainly based on corresponding themes rather than on explicit references.

Conclusion and discussion

The aim of this study was to examine how specific characteristics of collaboration in teams (interdependence, alignment and group cohesion) relate to teacher learning in innovative, temporary, and voluntary teams.

The actual collaboration in all five teams could be characterized using the category 'sharing' (cf. Little, 1990). However, 'sharing' was seen to have two aspects, each containing two subcategories: (1) the content of exchanges (*exchanging ideas* for alternative teaching methods and *exchanging and discussing experiences of experimentation* with alternative teaching methods); and (2) the problems that were identified

(identifying and solving *shared* or *individual* instructional problems). Collaboration in teams that focussed on exchanging both ideas and experiences of experimentation, and which aimed at shared problem-solving, had a higher level of interdependency than collaboration that consisted of exchanging ideas for alternative methods or which aimed at individual problem-solving. This conclusion is supported by results regarding the group context. Teams with a high level of interdependency often met teachers' initial expectations of the collaboration; teachers in these teams often reported a similar goal for the collaboration; and the level of group cohesion was high. Collaboration in teams with a lower level of interdependency did not meet teachers' initial images, and the teachers in these teams reported dissimilar goals for the collaboration. These teams showed average or below average scores of group cohesion.

The distinction in subcategories of sharing appeared to be helpful in explaining differences in teachers' learning results. Teams in which teachers exchanged ideas for alternative teaching methods and discussed experimenting with these alternative methods, and in which teachers started from shared problem identification, show a large number of learning results. In these teams with a high level of interdependency the teachers succeeded in aligning their goals for the collaboration, and a relatively high number of teachers changed their beliefs about teaching and learning in a way congruent with the aims of the reform. However, in these teams some teachers also changed their beliefs in a way that is incongruent with the aims of the reform. This could be explained by taking into account teachers' initial belief scores. Teachers who changed their beliefs in a way incongruent with the aims of the reform had high initial mean and maximum scores on student oriented beliefs. Thus, some ceiling effects may have occurred for these teachers (Meirink, Meijer, Verloop, & Bergen, 2009). Teams that merely exchanged ideas for alternative instructional methods, or that started from problems identified by individual teachers did not succeed in aligning their goals for collaboration, and appeared to be less effective in terms of changes in beliefs about teaching and learning.

As was stated before, this study was an effort to connect teacher learning regarding specific pedagogic innovations as part of a national reform, and changes in teachers' working contexts aimed at promoting teachers' learning, more specifically the introduction of innovative, temporary, and voluntary teams. The results show that interdependence in the working relationships within the teams played a key role in teacher learning. Furthermore, rather than analysing interdependence as consisting of a limited set of fixed and separate categories, the results gave cause to re-conceptualize interdependence as a dimension. At least within the type of 'sharing', subtypes were identified in this study. The types of collegiality or collaboration as classified by Little (1990) and Rosenholtz (1989), can be considered as defining parts of the dimension of interdependency.

Regarding the relationship between collaboration and learning, the results showed that collaboration and learning are closely interconnected. Individual teacher learning in these team contexts both encompassed changes in pedagogical beliefs and classroom practices regarding students' active and self-directed learning, as well as changes in their collaborative work relationships with colleagues in more or less interdisciplinary and aligned teams. This notion of interrelatedness of learning and organizing can be viewed as an alternative to the common assumptions about learning and collaboration, in which learning is viewed as the effect of collaboration as an organizational condition. Interdependent working relationships and alignment in their teams are to be viewed as co-created by teachers as actors, instead of organizational

conditions outside teachers' sphere of discretion. This insight can serve as a stepping stone in the efforts to connect the literature on individual teacher learning and organizational change in schools (Richardson & Placier, 2001).

This study identifies two paradoxes in daily school practice which administrators, principals and teachers have to deal with. Since the collaboration in some of the teams did not result in innovative teacher learning, it can be argued that collaboration between teachers in teams should meet some standard in order to be successful in terms of teacher learning. One such standard concerns position on the dimension of interdependence, more specifically the correspondence to different types of sharing. Teachers in teams should be stimulated by their leaders and coaches to *experiment* with alternative teaching methods in their practices in such a way that it contributes to solving a *shared* problem. Merely exchanging ideas appears not to be sufficient for teachers to learn from collaboration with colleagues in teams. In addition to exchanging ideas and experiences with experiments in teaching practice, teachers should also be stimulated and helped to develop concrete artefacts, for example lesson plans, assignments, etc, to be used by colleagues in and outside the team. When all teachers are held responsible for contributing to useful artefacts, the level of interdependence increases. Besides the importance of a high level of interdependency, it is important for teachers to experience autonomy in their collaboration with colleagues in teams. Both autonomy in the *process* of the collaboration and autonomy in the *topic* of collaboration should be considered important in this respect. School leaders and coaches can play their part in fostering teams' capacity to regulate the topic and process of their collaboration in such a way that it results in innovative learning. Here lies a direct parallel with just how teachers foster and motivate students to learn in a self-regulated manner. The steering towards and promotion of effective types of collaboration in teams with a high level of interdependency on the one hand (fostering exchanging ideas and experiences with experimentation aimed at shared problem solving), and on the other hand maintaining and fostering team autonomy to develop their own preferred style of collaboration is an intriguing paradox for school leaders. A second paradox concerns the innovative topic to be selected for teacher collaboration in the team. School leaders and administrators should give teachers a certain discretion in deciding which topic they consider important for their collaboration during a period of time. Nevertheless, with respect to continuing school development it is important for administrators and school leaders to guarantee the relevance of these topics for their entire teaching staff as well. Dealing with these and related paradoxes in terms of finding an optimal balance in the context of continually changing conditions in and around the school can be regarded as an important quality of effective school leaders and administrators.

Limitations of the study

One limitation of this study concerns the short period (one year) in which the teams were studied. This is a rather short period for teachers to start up and develop effective collaboration, especially with regard to the alignment of goals and initial images of collaboration. Therefore, it would be worthwhile to investigate such teams over a longer period of time in order to explore the effects on teacher learning in the long term. Examining teacher collaboration in teams over a longer period of time would also make it possible to examine images of collaboration several times during a period. This would provide information on the process of aligning goals and images

of collaboration. In this study images of collaboration were collected at the end of the year, so they can only reflect a reconstruction of an image rather than the actual images of collaboration.

Another limitation of this study is that we focussed on individual teacher learning in a context of collaboration by examining changes in individual teachers' beliefs about teaching and learning. Teachers' beliefs about teaching and learning were measured at a general level in order to compare the results found for the teachers of the five teams. For future research it would be also interesting to examine if and how teachers develop a shared view on how to foster active and self-regulated student learning during a period in which they collaborate in interdisciplinary teams.

Although no systematic data were collected on how the specific team characteristics developed, the temporary, voluntary, and task-oriented character of the teams in this study can be considered effective for innovative teacher learning. All teams functioned alongside existing subject matter department structure. This created the opportunity for the teams to focus on instructional innovation instead of daily concerns and organizational issues (cf. Crow & Pounder, 2000). This type of collaboration stimulated teachers to be open and less defensive about their own individual teaching practices, and consequently to learn from colleagues' feedback, and additionally also to learn by becoming acquainted with colleagues' experiences and difficulties with certain teaching methods. In order to learn from such exchanges of experiences, Little (2003) argues that 'classroom accounts that surface in interactions tend to rely heavily on a certain shorthand terminology, and on condensed narratives that convey something of the press of classroom life without fully elaborating its circumstances or dynamics' (p. 936). To foster learning in collaboration, teachers should try to represent their practice as specific and complete as possible (Levine & Marcus, 2010). In addition, teachers should discuss underlying principles and reasons for using a certain approach. Thus, fostering teams which exchange ideas, discuss their experiences and their underlying assumptions and which aim to solve shared problems may be regarded as a promising direction for initiatives aimed at teacher professional development with respect to educational innovations.

Acknowledgements

The authors would like to thank Inge Bakkenes, Annemarieke Hoekstra, and Rosanne Zwart for their collaboration on this project and particularly for their help with the construction of the data collection methods. Finally, we would like to thank two anonymous reviewers for their very helpful comments on an earlier version of this article. This research was funded by The Netherlands Organization for Scientific Research (NWO) (Project no. 411-01-251).

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Appendix 1. The Group Attitude Scale (Evans & Jarvis, 1986)

(1) I want to remain a member of this group.
(2) I like my group.
(3) I look forward to coming to the group.
(4) I don't care what happens in this group.
(5) I feel involved in what is happening in my group.
(6) If I could drop out of the group now, I would.
(7) I dread coming to this group.
(8) I wish it were possible for the group to end now.
(9) I am dissatisfied with the group.
(10) If it were possible to move to another group at this time, I would.
(11) I feel included in the group.
(12) In spite of individual differences, a feeling of unity exists in my group.
(13) Compared to other groups I know of, I feel my group is better than most.
(14) I do not feel a part of the group's activities.
(15) I feel it would make a difference to the group if I were not here.
(16) If I were told my group would not meet today, I would feel badly.
(17) I feel distant from the group.
(18) It makes a difference to me how this group turns out.
(19) I feel my absence would not matter to the group.
(20) I would not feel badly if I had to miss a meeting of this group.

Appendix 2. Overview matrix of results for type of collaboration, group characteristic and teacher learning

VARIABLES		Team A	Team B	Team C	Team D	Team E
I. Type of collaboration						
Interdependency	Intended collaboration	Joint work	Joint work	Joint work	Joint work	Joint work
	Actual collaboration	Sharing: exchanging ideas and experiences aimed at shared instructional problem-solving	Sharing: exchanging ideas aimed at shared instructional problem-solving	Sharing: exchanging ideas and experiences aimed at individual instructional problem-solving	Sharing: exchanging ideas and experiences aimed at shared instructional problem-solving	Sharing: exchanging ideas and experiences aimed at shared instructional problem-solving
Alignment: Number of reported shared goals		6	6	2	7	5
Alignment: Number of reported frictions in initial images and actual collaboration		0 (and 1 partial)	4	3	4 (and 4 partial)	0
II. Group characteristic						
Group cohesion	Mean	4.15	4.07	3.88	3.63	4.24
	SD	0.22	0.64	0.43	0.53	0.33
III. Teacher learning						
Number of changed beliefs	Congruent with reform	4	2	2	5	7
	Incongruent with reform	3	1	1	1	2
Learning experiences in digital logs	Category 1*	21%	10%	8%	14%	35%
	Category 2	16%	16%	0%	28%	10%
	Category 3	26%	24%	25%	37%	19%
	Category 4	37%	51%	71%	33%	35%

Note: *Category 1= learning experiences with explicit reference to collaboration in team; Category 2 = learning experiences in which topic corresponds with topic of collaboration in team; Category 3 = learning experiences as a result of collaboration with colleagues outside the team; Category 4 = remaining learning experiences.