Teacher researchers creating communities of research practice by the use of a professional development approach

Mona Holmqvist, Heléne Bergentoft & Per Selin

To cite this article: Mona Holmqvist, Heléne Bergentoft & Per Selin (2017): Teacher researchers creating communities of research practice by the use of a professional development approach, Teacher Development, DOI: 10.1080/13664530.2017.1385517

To link to this article: https://doi.org/10.1080/13664530.2017.1385517

© 2017 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

Published online: 07 Nov 2017.

Article views: 172

View related articles

View Crossmark data
Teacher researchers creating communities of research practice by the use of a professional development approach

Mona Holmqvist, Heléne Bergentoft and Per Selin

Faculty of Education and Society, Malmö University, Malmö, Sweden; Faculty of Education, University of Gothenburg, Gothenburg, Sweden

ABSTRACT
The aim of this article is to elucidate how teacher researchers use a theoretical framework as mediated tool to create boundaries in communities of research practices (CoRPs) and how this effects student learning. If, and in what way, knowledge developed in one practice can be used to inform the next is also examined. Two teacher researchers implemented two CoRPs each, one as internal participant and one as external participant. In total, 202 students, 22 teachers, 2 teacher researchers, and 1 researcher participated. The qualitative analysis is framed by Wenger’s three boundary dimensions: engagement, imagination, and alignment. The results show that teachers’ actions in the second practice, no matter if they were internal or external participants, are characterized by a higher degree of security and knowledge and the lessons implemented are more effective regarding the students’ learning outcomes than in the first. The results show that knowledge develops in an interaction order regardless of the internal or external community order. The result from the first team informs the starting point for the second team, and knowledge boundaries are transferred by the teacher researcher from one CoRP to the other.

Introduction

The aim of this article is to elucidate how teacher researchers use a theoretical framework as mediated tool to create boundaries in communities of research practices (CoRPs) and how this effects student learning. The phenomenon of ‘teachers as researchers’ has been discussed for several decades (Stenhouse 1981), at that time seen as an alternative to the main Western research culture, in which objectivity-seeking quantitative research on teaching has dominated the field (Gage 1989). In this paper, the focus is not how teachers and researchers can collaborate when doing research, as the teachers’ participation in a research school was aimed at developing ‘peripheral experiences’ (Gose 2014, 190) of how to work as researchers. After the examination, they re-entered their workplaces as school teachers and developers. In this way, the situation of the teacher researchers described in this paper differs from the main assumptions in, for example, action research, as the teachers in this case followed a formal
research program at the same time as they worked on their research projects. Hence, they belong to two different communities at the same time: teachers and researchers. One difficulty that arises when teachers carry out research in their own practice has been the different outcomes: teachers claim that they are problem-solving, while researchers are searching for an understanding of how to solve a problem (Gose 2014). The teacher researchers in our study experienced both communities simultaneously, bridging the gap between the two. Thus, the analysis strives to find out whether the teacher researchers can both find out how to solve the problem and test the theoretical conjectures for how to solve it in practice.

The teachers as researcher movement started several decades ago in the USA at a time when there were many calls for the professionalization of teaching and teachers (Cochran-Smith and Lytle 1999). Cochran-Smith and Lytle (1999) wrote about the changed situation a decade later, because of the standards movement, which ‘dominates the agenda regarding instruction, curriculum, assessment, promotion policies, and other aspects of school life’ (22). Even so, in the Western research tradition, research about teaching has mainly been on or about teaching and teachers, and more seldom with or by teachers. The teacher’s role in relation to research has been as the consumer or implementer, and this is a paradigm that Anderson and Herr (1999) suggested needed to be opened up, to create spaces ‘for more rigorous forms of practitioner research’ (20). They claimed that it is only through problem-solving in ‘messy’ school contexts that the agenda can be moved forward, with the aim of developing education for children. A decade later, teacher researcher projects and models were developed in different subject areas, such as mathematics (Gose 2014; Potari et al. 2010); special education (Babkie and Provost 2004), at different school levels, such as secondary education (Meijer et al. 2013); and in relation to assessments (Keeley 2011). Including teachers as collaborators in research has been beneficial for the process, and Lang and Page (2011) pointed out that the planning, implementation, and evaluation stages all benefit from teacher collaboration. Their results highlight benefits for ecological validity, in terms of the confidence with which the conclusions of an empirical investigation can be generalized to naturally occurring situations in which the phenomenon under investigation occurs (Cicourel 2005). One argument for collaboration with teachers or teacher researchers is that such communities also strengthen the social validity of the research results (Leko 2014; Wolf 1978).

In this project, a collaborative and iterative model for collaboration between teachers and researchers to study learning and teaching has been used to examine the creation of CoRPs. The approach used is Learning Study (Cheng and Lo 2013; Holmqvist Olander and Bergentoft 2014; Marton and Pang 2006; Marton and Tsui 2004), which is inspired by a Japanese tradition of teacher development called lesson study (Lewis, Perry, and Murata 2006; National Association for the Study of Educational Methods 2011; Stigler and Hiebert 1999), but also teacher research groups (Salleh and Tan 2013), open lessons (Shen et al. 2007), lesson preparation groups (Paine and Ma 1993; Salleh and Tan 2013), and improvement science (Langley et al. 2009). The common feature in all the above-mentioned approaches is that they all follow a collaborative, systematic, and iterative process to study learning and teaching in the classroom and other workplaces (e.g. improvement science). The model has been adjusted to Western school contexts, where this project is placed, since the early 2000s (Marton 2015). Therefore, we have limited focus on the teachers’ assignments in this study to the interaction between teachers and students in subject-based learning activities.

The Learning Study approach used to create CoRP in this project takes as its starting point a general theory of learning as a guiding principle or mediating tool for the study of
classroom instruction made through collaboration between researchers and teachers or by teachers. In this particular case, variation theory (Lo 2012; Marton 2015; Marton and Booth 1997) is used. A theoretical framework is introduced in order to create a common and explicit use of shared knowledge of concepts for analyzing classroom activities. Through systematic and iterative projects, in which the conjectures of the theory are used as guiding principles in the classroom instruction, the teachers measured the impact of the theoretical ‘cues’ in order to examine their efficiency and the impact they have on students’ learning at different levels, and how they work in different contexts and for different contents. In this way, teachers do not examine their own or their colleagues’ work or actions in the classroom in the first instance, but create CoRPs studying how learning is offered to students and how the content is handled in the classroom in the discourse to which both students and teachers contribute. No matter how strongly the teachers believe their joint design is the best way to teach, the intention is to further develop their own understanding about teaching students, as well as students’ learning.

**Models developing teachers’ communities of practice**

Lave and Wenger (1991) defined a ‘community of practice’ as participation in an activity system in which participants have shared knowledge of what they are doing and of what it means to them, each other, and society. In the present study, participants’ different viewpoints, actions, and negotiations are focused on a community of learning in which the reproduction of scientific knowledge, a research community, is studied. Lave and Wenger (1991, 98) described a community of practice in the following terms.

> It is possible to delineate the community that is the site of a learning process by analyzing the reproduction cycles of the communities that seem to be involved and their relations.

In models for communities of practice developed in South-East Asia, teacher collaboration can be done through formal and explicit associations of teachers, informal associations, and invisible relationships among staff within a school, as well as through distance collaboration, chiefly through teachers’ stories published in educational journals and books (Paine and Ma 1993). However, their nexus of practice differs slightly and the actions carried out as well (Scollon and Scollon 2004). Models that are frequently used include teaching research groups (TRGs), jiaoyanju, and lesson study, kenkyū jugyō. In a TRG, the teachers have a collective orientation to teaching in practice (Paine and Ma 1993). A typical TRG consists of three to seven teachers, and is organized on the basis of subject area, since most teachers only teach one subject. The head of each group is recognized as the best, or one of the best, teachers in the group, and each group has weekly meetings and frequent group activities (Paine and Fang 2007).

In the TRG model, the teachers can be considered as teacher educators, working with colleagues to educate each other about teaching (Salleh and Tan 2013), and as researchers, conducting research on teaching, curricula, and learning. The Chinese ‘learn-in-doing’ model for teacher development, action education, absorbs and builds on the accumulated wisdom of practice through an iterative process (Paine and Fang 2007). The aim of action education is to identify the gap between the vision of teaching and learning in the new curriculum reform and actual teaching and student learning. Lessons are analyzed and redesigned with reference to three factors: important points, difficult points of learning, and hinge points of teaching (Paine and Fang 2007; Yang 2009; Yang and Ricks 2012). The discussions in TRGs are centered on teaching aims, focusing on key tasks, and ultimately concerned with
students’ actual learning in lessons (Yang 2009), and it is common for the results to be published (Shen et al. 2007).

Another frequently used model for creating teachers’ communities of practice, lesson study, was developed in the nineteenth century in Japan, and enables teachers to develop and study their own teaching practices in collaboration with other teachers (Baba 2006; Fernandez 2002). In Japan, participation in school-based professional development groups is considered part of the teachers’ profession at all stages of their careers (Lewis and Tsuchida 1999; Okubo 2006; Stigler and Hiebert 1999). It is a systematic process in which teachers in teams progressively strive to improve classroom teaching and reflect on the merits and deficiencies of lessons. Japanese teachers see themselves as developing the profession as well as themselves (Stigler and Hiebert 1999). In Japan the educational system and national curriculum are centralized, and the division of content into lessons is done in a similar way for all teachers of a given grade level and subject (Stigler and Hiebert 1999). Thus, knowledge developed about a specific lesson or sequence of lessons is highly sharable with teachers all over the country who are teaching the same content. The research theme or focus of the year should address the area in which there is the widest gap between the students’ knowledge and the ideas espoused by their teachers (Doig and Groves 2011). The lesson study process is also cyclic (Lewis, Perry, and Murata 2006): it consists of preparation, research lesson, review session, and a new cycle, in which the lesson is refined, and has an unrelenting focus on student learning (Doig and Groves 2011; Lewis 2000; Stigler and Hiebert 1999). The research lesson is observed by colleagues and sometimes also filmed and observed by university instructors and supervisors from the board of education (Isoda 2006). The core of the teaching is the way in which a teacher and students interact about the content, and professional development is assumed to be a key to educational improvement (Perry and Lewis 2009). From its origins in Japan, lesson study has spread to other countries such as the USA, South Africa, England, Germany, Iran, and South Korea (Doig and Groves 2011; Lewis, Perry, and Friedkin 2009).

Learning study, which is used in the current research, is based on the South-East Asian tradition, guided by the assumptions of a theory of learning. The theoretical framework is used to enhance the common language in the discussions, which underpin the iterative way in which the teachers plan, implement, and review the research lesson (Pang and Ling 2012). In a learning study, teachers investigate their students’ learning difficulties and examine their teaching strategies in relation to the student learning outcomes, based on theoretical assumptions as a guiding principle (Adamson and Walker 2011). Learning study can be described as a form of action research (Cheng and Lo 2013) that has similarities to educational design research (McKenney and Reeves 2012). The primary focus of a learning study is an object of learning – what is supposed to be learned during the lesson – rather than an actual learning activity (Adamson and Walker 2011; Lo 2012; Pang and Ling 2012). How the object of learning is framed during the lesson is studied by microanalysis to identify how teachers and students interact about the content. The relationship between the intended, enacted, and lived object of learning is a point of departure in learning study (Marton and Tsui 2004; Pang and Ling 2012). The intended object of learning is created by the teachers, based on established frameworks such as the formal national curriculum and syllabi, as well as their experience of teaching and the students’ knowledge. The enacted object of learning is how the content is handled during the lessons, and in a discourse where both teachers and students take part in order to open up the space for learning, i.e. what it is possible to learn.
Using video-recordings, the lesson can be analyzed by teams of teachers and researchers. What students see, understand, and create meaning from after the lesson and onward is the lived object of learning, and this is examined by assessments of different kinds. The teacher’s task is seen as creating a space for learning by highlighting what is required to enable learning within a specific area (Lo 2012; Marton and Booth 1997; Marton and Tsui 2004; Runesson 2006).

Variation theory is the explicit learning theory that has mainly been used in learning studies (Holmqvist 2011; Lo 2012; Marton 2015; Runesson 2006). According to variation theory, an object of learning consists of different sets of aspects and features. Those aspects that would increase students’ learning, and have not previously been discerned, are called critical aspects. Learning is defined as changing one’s way of seeing or understanding the object of learning (Lo 2012; Marton 2015). Variations of aspects of the content are made to enable students to experience features that are critical for further learning. What we want students to learn – the critical aspects or its features – must be varied against an invariant background consisting of aspects that are not critical (Lo and Marton 2012; Pang and Marton 2003).

The use of variation theory as an explicit learning theory in learning studies provides teachers with a context and space in which to reflect on their classroom practice through collaborative work between teachers and researchers (Elliott 2012), which in turn creates a shared language of professional discourse (Lo 2012). The way in which teachers view and relate to students can be permanently changed through learning study, which can also make teachers more self-reflexive in their interactions with students (Elliott 2012). Thus, the method provides a context for professional learning grounded in practice (Lo 2012).

A learning study starts by defining the object of learning, taking into account the learners’ perspective and knowledge, as well as subject-based knowledge of the content to be taught. This is followed by the design of pre- and post-tests and of the first lesson. The design is implemented with one group of students, and usually video-recorded and analyzed by the team aiming to relate the students’ learning outcomes with what actually happened during the lesson. In the post-lesson meeting, the analysis focuses on which aspects of the content or ability the students developed, and which they did not develop. The result informs the design of the next lesson, which is tried out with a new group of students. The cyclic process is repeated, and the results of the two cycles are compared both within and between the cases. One or several more cycles are conducted until the team has reached an understanding about the necessary conditions for learning for the specified object of learning or the targeted ability.

**Research questions**

In this study, ‘teachers as researchers’ could be understood as teachers formally becoming researchers, as the teacher researchers in this study also were students in a research program. Three research questions were designed to achieve the aim of the study, namely to elucidate how teacher researchers use a theoretical framework as mediated tool to create boundaries in internal and external CoRPs, and how this effects student learning. Secondly, if and in what way knowledge developed in one practice can be used to inform the next, is also examined:
RQ1. What characterizes the use of theoretical boundaries to create CoRPs?
RQ2. In what way does the internal/external school context affect the negotiation in a CoRP?
RQ3. In what way can results from CoRP be transferred to enhance student learning in other CoRPs, by the mediation of a theoretical framework?

Methodology

We conducted a meta-analysis of four projects undertaken by two teacher researchers (two projects each) in collaboration with teachers (Bergentoft 2014; Selin 2014) from a Swedish school context. In-service teacher training is in Sweden optional and differs between schools as the school management grants and decides on the in-service training offered. The curriculum states the goals each student should achieve, but the teacher has to interpret and negotiate with other teachers, students, and parents about how to implement the work to achieve the goals in a suitable way. There are very few guideline instructions of what methods to use. The teachers are expected to solve how to design instructions, and for this, they also need to discuss and share different opinions about how to work with their colleagues.

Both of the teacher researchers are teachers in secondary school who graduated from a four-year teacher training program at university level. They are experienced teachers in their subjects, and have been teaching for 29 (A) and 12 (B) years. They have also participated for 2.5 years in a licentiate graduate program for teachers at the university, and the learning studies were implemented during their studies, with supervision from senior researchers. A Swedish licentiat program is a two-year doctoral program. During the program, the teacher researchers A and B (TRA and TRB) led two learning studies each (see Table 1), from which the data for analysis in this article were collected. TRA and TRB have been visiting the participating schools from the unfamiliar context several times, as they were included in a team of researchers from the university involved in a large school development project initiated by teachers and leaders from the same secondary school. As the teacher researchers are asked for as supervisors by the teachers from the participating school, they were easily accepted as supervisors also at the school which they were not previously familiar with.

As different practices were used to collect data for the analysis, it is important to mention that the two different studies (where the TRs are either internal or external participants) were included in the design, to analyze whether – and if so, how – they differ regarding using a theoretical framework as a mediated tool as a boundary object to create CoRPs (Wenger 2000). Wenger says that ‘shared practice by its very nature creates boundaries’ (232). There are differences in boundaries depending on in which context they are created, e.g. organizational boundaries are created by the organization, and boundaries in a community of practice are more fluid as they are based on the participants’ shared interest. In this study, the teacher researchers and teachers come from the same school context in one case and in one from another. The tension between competences and experience is by Wenger seen as a resource for learning within systems. In this study, a theoretical framework is used as a mediated tool to develop boundaries within different groups of teachers. Due to differences

Table 1. Design of studies, teachers, and teams.

<table>
<thead>
<tr>
<th>Teacher researcher</th>
<th>First study</th>
<th>Second study</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unfamiliar team</td>
<td>Familiar team</td>
</tr>
<tr>
<td>B</td>
<td>Familiar team</td>
<td>Unfamiliar team</td>
</tr>
</tbody>
</table>
and tensions between the participants’ experience and knowledge, new learning develops in collaboration.

TRA’s projects aimed to develop teachers’ understanding of how teaching can be designed in relation to different aspects of physical ability in the school subject physical education and health. In total, 95 secondary school students aged 16–19 years from two different schools participated, 57 students in the first (A1), of which 10 students also attended an initial screening, and 38 students from the second (A2). Seven teachers divided into two groups participated in one study each. The results from the first study were taken into consideration by the teachers in the second study, and the results were used in the new group of teachers and students. TRA was an external participant in the first study, and internal in the second.

TRB conducted three cycles in each of the two studies. Students’ learning outcomes were assessed by analyzing their learning in terms of changes in ways of interacting when learning English as a foreign language. In the first study, 29 students in Year 8 (13–14 years old) participated, and in the second, 57 students from the first year of secondary school (16–17 years old). Two teams of teachers participated, six teachers in the first study and nine teachers in the second (Table 2). Each student group only had one lesson each, which means that every lesson had different groups of students. TRB was an internal participant in the first study and external in the second.

Both the external teams of teachers had no previous experience of variation theory or learning study, while both internal teams are familiar with both the theoretical framework and the model.

The timeline of the four studies is presented in Table 3.

Analysis

The unit of analysis is four communities of practice, and data for the analysis are audiotaped meetings in the four communities (n = 28, 7 in each community), video-recorded lessons (n = 11, 2–3 in each community) used for analysis during the meetings in the communities, and pre-, post-, and delayed post-tests (3 per student). The test results are used as indicators of how effective the teachers’ use of the theoretical framework to enhance student learning is. All materials are either transcribed verbatim or compiled quantitatively (test results). A qualitative analysis was carried out to examine in what way variation theory as a mediated tool to create boundaries was developed, and how this helped the teacher TRs and teachers to create communities of practice (RQ1). The first step was to read and find utterances at the meetings of how the teachers use theoretical assumptions as common concepts to analyze and predict student learning. The interaction order differed between the teacher researchers.

Table 2. Participants and contents of the four studies.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Study A1</th>
<th>Study A2</th>
<th>Study B1</th>
<th>Study B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher researcher</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Teachers (F/M)</td>
<td>3/2</td>
<td>0/2</td>
<td>1/5</td>
<td>1/8</td>
</tr>
<tr>
<td>Students (F/M)</td>
<td>26/21</td>
<td>22/16</td>
<td>12/17</td>
<td>53/25</td>
</tr>
<tr>
<td>School year</td>
<td>11</td>
<td>10 + 12</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Content</td>
<td>Body posture of upper body while running</td>
<td>Body posture while running</td>
<td>Use of phrases to ask for items and directions</td>
<td>Use of phrases to create an effective conversation</td>
</tr>
</tbody>
</table>
TRA was an external participant in the first community and internal in the second, while TRB had the opposite situation. The second step in the analysis was to compare the data to find similarities and differences due to the internal and external internships (RQ2). During this step, there was a focus on the use of a theoretical framework as a tool to create boundaries between the participants and if the order of the contexts (internal/external) matters. The material is studied from three levels; engagement, imagination, and alignment. With regard to engagement, the teachers’ research communities are characterized by collaborative work to solve a problem; the teachers help each other and try out their lessons to find out whether they are suitable. The mediating tool used is variation theory (Marton 2015), a perspective on instructional learning which is used to engage the participants to design developing learning situations for the students. The framework also becomes a mediating tool for creating boundaries shaping the community of practice. Imagination refers to the process by which the teachers try to find out what conjectures of the framework should be used to enhance the students’ learning (RQ3). Alignment refers to how the teachers jointly discuss and try to understand the problem, but also negotiate and collectively design a lesson plan that is revised and tried out in different groups of students, by different teachers, trying to do their best to ensure the conjectures work beyond their own engagement (RQ3).

Results
To achieve the aim and answer the research questions, a chronological examination of each study is presented, followed by an analysis of all four studies. The students’ test results from each study are presented as indicators to highlight whether there are differences in the impact of the use of theoretical assumptions in the different participation (internal or external). The results of the students’ learning outcomes are descriptively compiled and presented in Table 4.

Study A1
In the first learning study, which focused on physical education and health in the external group, the teachers’ mutual engagement was to develop teaching and learning about the object of learning ‘body posture while running’. TRA had experience of supervising one learning study before, however the teachers did not have any former experience of learning study and variation theory. Variation theory as a mediating tool was introduced for the teachers by TRA. The teachers’ negotiation of a joint enterprise resulted in a decision to focus on the upper body in order to limit the number of critical aspects. One step in the development of

<table>
<thead>
<tr>
<th>Teacher researcher</th>
<th>Study</th>
<th>Context</th>
<th>Study conducted</th>
<th>Number of community meetings</th>
<th>Number of cycles</th>
<th>Implemented lessons</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A1</td>
<td>Unfamiliar</td>
<td>Sept 9–Nov 11 2012</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>Pre/Post</td>
</tr>
<tr>
<td>A</td>
<td>A2</td>
<td>Familiar</td>
<td>Sept 30–Dec 17 2013</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>Pre/Post</td>
</tr>
<tr>
<td>B</td>
<td>B1</td>
<td>Familiar</td>
<td>Aug 21–Dec 13 2012</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>Pre/Post/Delayed</td>
</tr>
<tr>
<td>B</td>
<td>B2</td>
<td>Unfamiliar</td>
<td>Jan 22–June 4 2013</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>Pre/Post/Delayed</td>
</tr>
</tbody>
</table>
a shared repertoire of resources for creating meaning was to design a practical running test (pre- and post-) to assess students’ learning using an assessment template focusing on the placement of head, shoulders, chest, arms, and hips during movement. The teachers negotiation defined some aspects of importance for the assessment: head and eyes should be up in the running direction, shoulders relaxed, chest lightly thrust forward, oscillation of the arms in the running direction, not crossing the middle line of the body, hips straight, not flexed. In order to increase the reliability of the assessment, each test was assessed by two different teachers. The discourses in place are the teachers’ goal to create instruction based on what they want to tell the students, while TRA tries to base the instruction on theoretical assumptions. The teachers’ have experience from previous lessons, the outcomes of their instruction while TRA has experience both as a teacher and as a PhD student with a developed theoretical perspective about necessary conditions for learning.

The three lessons in the first study started in a classroom. Here, the students watched film clips showing two different running styles, one inefficient and one optimal, presenting a set of different critical aspects each. The assumption about contrasts from variation theory was used as a mediating tool. The mutual negotiation resulted in a battery of resources for creating meaning. The students were asked to identify the differences between the two running styles in order to identify important aspects of a running motion and to develop awareness of the more optimal, economical style of running. The students then went outside to try different ways of running. In the first lesson, the students were supposed to discern differences between various locations of the head, shoulders, chest, arms, and hips while running. Contrasting two different positions of the same body part was intended to focus the students’ immediate awareness on each body part, and thereby place each part in the foreground. The result from lesson A1:1 showed that students’ learning outcome on a scale of 1 to 5 was +1.4 (52%): they went from 2.7 out of 5 in the pre-test to 4.1 in the post-test. In the post-lesson analysis, the teachers and TRA discussed if the offered content was suitable to develop running styles.

A:  Do you see how the different body parts’ positions affect each other?

B:  Now we introduce contrast from the head downwards in the body. Wouldn’t it be better in the reverse direction?

A:  Certainly, as development goes from the bottom up and inside out.

B:  Shall we try to start with the hip instead, then? [Authors’ translation]
The negotiation resulted in a change made in order for students to better discern each body part and its effect on body posture, in line with the theoretical assumptions. The teachers identified some aspects that made them change their meaning-making about what is needed in order to learn the content. During the second lesson, it was thus decided to introduce two new critical aspects necessary to enhance learning: kinetic energy and center of gravity. Both of these critical aspects were varied by partial running focus, in line with the conjectures of the theoretical framework used. The students would stand still and, for example, just move their arms, to discern what happens in terms of kinetic energy if the arms are moved in the running direction rather than if they cross the middle line of the body. In lesson A1:2, the students’ average score went from 1.9 out of 5 in the pre-test to 3.6 in the post-test, an increase of +1.7 (89%). The hip and its importance to the posture appeared as an important aspect during the analysis of the second lesson. The teachers discussed different ways to contrast the placement of the hip, and the negotiation was based on the theoretical framework and engaged all of them, not just the teaching teachers. It was eventually decided that in the third lesson, there would be a test of whether the lower back and sitting style of running would be two critical features of this aspect, as a new recourse for meaning-making. The last exercise in the third lesson (A1:3) was increased running speed, keeping the posture as optimal as possible. This was an exercise that used the conjecture of generalization, where the posture is invariant while the speed varies in order to maintain good posture regardless of running speed. During the analysis of the third lesson, the teachers found that small changes in the pattern of variation can have a significant impact on student learning. In this lesson, the teacher introduced a partial motion focus on arm oscillation before students experienced contrasting techniques of arm oscillation while running.

There seem to be differences in how students understand the partial running focus depending on when it is introduced. In the previous lesson it came after the students had been running; now they had it in reverse sequence, which doesn’t seem to create the same understanding. [Author’s translation]

However, the results showed that students in lesson three had the smallest increases in test scores (+1.2, 57%). On average, the students went from a mean of 2.1 out of 5 in the pre-test to 3.3 in the post-test. The use of theoretical boundaries in this first study points at the teachers using the theoretical conjectures to support their assumptions, and to limit the object of learning by defining what aspects and features it consists of. They also elaborate on what aspects should vary and why. Different patterns of variation were also used, contrasts of sets of aspects in different representations (running posture invariant but speed varies) as well as same running speed but differences in body posture.

**Study A2**

Based on the teacher researcher’s knowledge from the first study, the second team’s aim was to work with an approach that took a more holistic view of the content. In this study, the teachers partly shared TRA’s previous knowledge as they had conducted one learning study before. The analysis of study A1 indicated that it was not possible to treat the upper body as isolated from the legs, and thus, the second study focused on the entire body. The analysis also highlighted the importance of personal experience in enabling students to fully understand theoretical explanations. This knowledge was brought into the new team...
of teachers in the familiar context by TRA. This was not negotiated in the new team. The teachers in the second study decided instead to use the information by letting students’ own experience of the running movement be the focus from the start. A new resource for creating meaning was decided upon.

TRA: Should we allow the students to video-capture each other, in order to get an outside perspective on their own movement?

D: Yes, why not? It gives the students an additional way to develop their understanding.

[Authors’ translation]

In the first lesson, the teachers had negotiated how to assess the knowledge and decided to re-use the resource for meaning-making from the first team. Thus, the students did the same assessment questionnaire from study A1, focusing on the five parameters identified: head, shoulders, chest, arms, and hips. The task was to assess students’ styles of running in relation to what they believe is an ideal running style. The intention was that the students should start thinking about how they run and whether their own style of running is optimal, which required them to begin to think about what a good running style means. The students video-recorded each running style, and studied the recordings collectively afterward. The next resource for meaning-making that was decided by the teachers was watching footage from a 1500-meter race at the men’s IAAF World Championships Final in 2013 to identify how professional runners positioned their head, shoulders, chest, arms, and hips, but also to think about why they do what they do. In parallel, the personal styles of two runners were observed, and this enabled a discussion of the similarities and differences between what runners do. The decision to use this material was based on the theoretical conjecture about contrasts. It was also decided that students could watch the film clips themselves in order to identify similarities and differences regarding the five selected points. Similarities and differences are assumptions from the theoretical framework (boundary object) used by the members of the community to design instruction. After watching the athletes running again, they were asked to make a new assessment of their own running style in relation to professional runners’ placement of the five body parts. Based on the profile each student now had of their own running style, they were given the task of changing any of the features they were not happy with on the next running attempt. The teachers’ analysis of the results of this lesson (A2:1) showed that students on average went from 2.5 out of 5 in the pre-test to 4.6 in the post-test. This was a significant increase (+2.1, 84%). The increase indicates that the teachers’ skills to use the boundary object (variation theory) in combination with the knowledge from study A1 speeds up the ability to design challenging lessons. In the next lesson (A2:2), the teachers wanted to let students identify the five critical aspects on their own. The lesson began with a running student being filmed by a peer. The intention was that the students should be able to identify the critical aspects by discerning similarities and differences between their own and their peers’ running styles. The different student groups’ conclusions were followed up with a whole-class discussion. The students then watched the same race as in lesson 1 to identify how professional runners position the five focused body parts. This was followed, as in the first lesson, with a video study of their own style of running in order to identify what could be improved. In the second lesson, the result was 2.4 out of 5 in the pre-test and 4.1 in the post-test, an increase of +1.7 (71%).

The assessment showed that the learning outcomes in the second study (A2) increased more than in the first (A1). The ability to use an optimal body posture while running increased.
in all five classes, although lesson A2:1 had the highest increase, +2.1 (84%), where the students scored 4.6 out of 5 in the assessment. The majority of the comments from the students during the lessons related to the less efficient style of running, indicating the importance of using contrasts while teaching about physical abilities in a specific context. The results indicate that a lesson design that was negotiated and developed by one group of teachers can be used by a new group of teachers as part of a cumulative process, by pointing out what pattern of variation had the highest impact on student learning, which is one of the conjectures in variation theory. In A2, both teachers and TRA have experience of using the theoretical framework. Initially, it seems as if they developed the necessary conditions for learning to a greater extent. Variation theory as a boundary object was already incorporated in this community. The teachers used variation theory in a more advanced way than the teachers in A1 did, by letting the students search for the critical aspects already defined in A1 by examining them among various cases, e.g. professional runners, themselves, and peers. They also included aspects from all parts of the body which challenged the students to take more aspects into consideration.

Study B1

In TRB’s projects, students from K8 participated in the first study and students from the first year of secondary school (K10) participated in the second study. The teachers’ and TRB’s experience of variation theory and learning study was rather similar as both had experience of conducting this kind of study. The theoretical assumption, taken from the variation theory of learning, was negotiated and used as a resource for meaning-making. The object of learning in the study B1 was that the language used in oral interaction must be adapted to the interlocutor who is being interacted with. The students were presented with three different ways of addressing people when asking for directions, varying according to their level of formality. The team decided to use a role play in which students acted the roles of information seeker, peer, and stranger and in which the content – the need for direction – was invariant, but the interlocutor was varied; through this, the students would develop the targeted knowledge. The information-seeking student first asked the peer for directions, but this student was instructed to say they did not know, so the stranger had to be addressed. The information-seeking student was then supposed to change vocabulary to a more formal request. The students’ learning was assessed through the use of pre-, post-, and delayed (six weeks after the lesson) post-tests. The team listened to the recorded tests, conducted in groups where students talked, and qualitatively assessed the students’ usage of phrases that differed in formality to address peers and strangers. The qualitative analysis of the result from lesson B1:1 showed that nine students out of ten adapted their language at the post-test compared to no students at the pre-test. At the delayed post-test, five students out of ten adapted their language. A video analysis of the lesson was used to revise the lesson. The common goal to develop the lesson is based on an aim to enhance the students’ communication. However, variation theory is implicit during their negotiation:

E: Isn’t it a rather boring lesson? They don’t really interact that much.

F: But they are not really into their roles. Wouldn’t it be better if they were introduced to their roles? Like ‘This is what an adult is like and this is what a shop assistant is like’, and so on?

TRB: That might be a good idea. [Authors’ translation]
The change was made in order for the students to better understand one of the critical aspects of the object of learning. This critical aspect was how to address different persons differently (information seeker, peer, or stranger). These three roles were discussed in class during lesson 2 using questions such as ‘What do you say as a 14-year-old?’ and ‘How do you act as a grown-up?’ Both situations include a set of different and varied features which are more or less critical for different students’ understanding. Result of the second lesson (B1:2) showed that six out of nine (67%) students adapted their language at the post-test compared to two out of nine (22%) at the pre-test. Eight out of nine (89%) students adapted their language at the delayed post-test. During the mutual engagement during the video analysis, the teachers found that the students had been too focused on their own roles and had lost sight of what was intended to be the focus, namely the role of the interlocutors.

E: It feels like they are acting.
G: Listen to [one of the pupils]. He is playing a role.
F: Perhaps they need to know how to speak to a particular person and not as a particular person?
E: But won’t we get back to lesson 1, then?

TRB: Don’t forget the object of learning. It’s not to act – it’s to interact. [Authors’ translation]

The discussion preceding lesson B1:3 ended with a decision to keep a stronger focus on the interlocutors. The result showed that all the students adapted their language at the post-test compared to only one out of ten at the pre-test. All students also adapted their language at the delayed post-test. In study B1, the negotiations went smoothly as all participants had experience of the boundary tool (variation theory). As the content taught had not previously been studied, TRB did not have any experience to bring into the team. The use of theoretical boundaries among the participants is in this study characterized by using patterns of variation and invariance to make students discern that the same question can be addressed differently by changing the interlocutor. Therefore, the students have to consider what aspects are of importance to address the same message differently depending on who you are talking to.

Study B2

Students from the first year of college (16–17 years old) participated in study B2. The theoretical assumption (variation theory) was similar to that in study B1, and the object of learning was also similar. The main difference between B1 and B2 is that the students were two years older and that the teacher researcher in the B2 study is not a teacher at the school, and therefore an external participant. Another difference is that the teachers in this team did not have any experience of variation theory. Again, the teacher group negotiated about what they were aiming for.

H: I think we practice it [varying language] too little, and when we do it is related to writing.
I: We need to construct a vocabulary.

H: The oral assessment is a little bit passive. [Authors’ translation]

They decided that the students should learn how to adapt their language to suit the interlocutor. The teachers in the research group wanted the students to learn the usage of phrases for: (1) inviting people into a discussion; (2) referring to what other people have said; and
introducing their own opinion with a phrase other than ‘I think.’ It was hypothesized among the teachers that the students already knew the phrases and that they needed to learn how to use them. In the first lesson planned, a contrast was made between an ‘ineffective’ conversation and a more ‘effective’ one through the use of a role play in which students acted according to instructions on role cards. Both situations included a set of critical features each. This was based on the theoretical conjecture about contrasts. On the cards the students were explicitly told to not invite, refer, or use anything other than ‘I think.’ This role play was later contrasted with a recorded example of a conversation in which all three aspects mentioned above were carefully considered. There followed a discussion during which phrases that could be used were written on the white board, and the students then had a new conversation with role cards, this time reminding them to invite, refer, and use several different phrases for expressing opinion. The analysis of pre-tests in lesson B2:1 showed that in 10 out of 15 of the conversations, at least one phrase for any of the three focused areas was used. The same result was found after the post-test. A delayed post-test was carried out eight weeks after the lesson and in this test all conversations (15 out of 15) contained at least one phrase of each kind. After a video analysis of lesson 1, the teachers collectively decided that lesson 2 should focus more on learning usage of phrases and not on learning phrases as such. The focus should be on communication and not on memorizing phrases.

So, with a smaller selection [of phrases] the chances that they actually use them would increase. [Authors’ translation]

Therefore, the number of phrases written on the white board was reduced. The recorded conversation was also changed. It was believed that a recording of older students from the same school would be more natural for the students. Apart from these changes the lesson was similar to lesson 1. The results from B2:2 show that in four conversations out of twelve at the pre-test, at least one phrase from the focused areas was used. In the post-test at least one phrase was used in nine out of twelve conversations, and in the delayed post-tests (eight weeks after the lesson) in eleven out of twelve. In the teacher discussion following lesson B2:2 it was decided that a sharper contrast between the more developed and undeveloped examples of conversations should be used. This contrast became a new resource for meaning-making and was the change for lesson 3. It was also discussed that more than one thing was changed compared to lesson 1, which had fewer phrases and recordings.

The pre-test was changed. And then we also agreed that I shouldn’t have a mix of different expressions, and finally we had changed the input text [that the pupils were listening to]. Those are three things. How can we be sure which one of them mattered? [Authors’ translation]

The teachers were interested in finding out, in a scientific way, which aspect was most important and designed a kind of quasi-experiment. In fact, they negotiated and decided to try out two different hypotheses. It was therefore decided that there should be two versions of lesson B2:3, implemented in two different groups of students, one with a similar treatment of the phrases as in lesson 2 (with a limited number of phrases written on the white board, referred to as lesson B2:3.1) and one similar to lesson 1 (referred to as lesson B2:3.2). The results from the pre-test for lesson B2:3.1 show that at least one phrase from the focused areas was used in three of the twelve (25%) conversations. In the post-test, it was used in nine out of twelve (75%) conversations, and in the delayed post-test (eight weeks after the lesson) at least one phrase was used in all conversations (100%). For lesson B2:3.2, the result from the pre-test showed that at least one phrase was used in 8 out of 18 (44%) conversations.
In the post-test, it was used in 15 out of 18 (83%) conversations and in the delayed post-test (8 weeks after the lesson) it was used in 16 out of 18 (89%) conversations. The highest increase was thus in lesson B2: 3.1 (from 25 to 75%, +50 percentage points), while the students in B2:3.2 reached the highest scores in the post-test (89%) regarding adopting new ways of expressing themselves when communicating. In this learning study, the teachers’ ways of using the mediation tool (variation theory) are in predicting learning outcomes by testing different lesson designs. The CoRP seems in this case to be more developed in B2 than in B1, even though the teachers had no previous experience working with it, as the teachers really used the theoretical assumptions to predict and investigate student learning. TRB has contributed with his experiences from B1, and the result informs B2’s work in a way that compensates for their lack of experience. In this study, the pattern of contrast was used to show two contrasting representations with different sets of aspects – ineffective communication and effective – to make the students discern the aspects critical for understanding what has an impact on communication. Then they were introduced to different goals for communication and how this gives implications for differences in the way to communicate, as well as addressing different interlocutors.

In Table 5, the boundary dimensions created during the project are described. In the horizontal plane, how the groups coordinate their interest, share their knowledge in a transparent process, and negotiate to shape a common understanding are described. In the vertical direction, their engagement in the problem, their imaginations shared, and the direction of their interest and work shaped by a joint alignment are described.

Conclusions and discussion

The first question was ‘What characterizes the use of theoretical boundaries to create CoRPs?’ The design, with one study in a familiar context and one in an unfamiliar context (unknown
to the researcher and without previous knowledge about variation theory and learning study) for each teacher researcher, uncovers the differences there might be in conducting research as an ‘insider’ or ‘outsider’. However, there are limitations in the design, namely the different ages of the students’ in study B, which might have an effect on the results. Also the small number of studies and the difficulties in comparing between studies with different content taught limit the possibility to generalize to other subjects, and to students’ different needs. Even so, the results highlight interesting findings. With regard to mutual engagement (Lave and Wenger 1991), the teachers in all four studies are engaged, and they design, analyze, and revise the lessons as a team. They use the mediating tool (Scollon and Scollon 2004), variation theory (Marton 2015), as a boundary object (Wenger 2000) to develop joint knowledge about necessary conditions for learning. In this respect, no difference was observed between the internal and external contexts. However, a difference was found regarding the order of the studies. As TRs brings knowledge from one group to the next, results and aspects identified by teachers from the first round can be used and tried by the second team. The experience of how content-specific knowledge has been developed in a former group of students informs the next study, no matter if it is a familiar or unfamiliar community. The theoretical knowledge seems thus to be crucial for the TRs, but not the teachers. TRs inform the research practice, which is addressing the second research question ‘In what way does the internal/external school context affect the negotiation in a CoRP?’ When analyzing the discussions for both studies (Bergentoft 2014; Selin 2014) in the familiar contexts (A2 and B1), they ran more smoothly as they were introduced to the theoretical concepts before and the teachers’ negotiations ended with agreements on how to design instruction. In A2, the team was satisfied with the result after one cycle. In study A1, external context, the teachers and the TRA did not agree on separating the body into two sections and focusing on the top half (Bergentoft 2014). In study B2, the teachers and TRB did not agree on a mutual resource (lesson) to try out; instead, they agreed to implement two different designs to identify which aspect was the major one affecting the students’ learning outcomes (Selin 2014). These kinds of contradictions have been found to be useful for further learning (Wenger 2004). In study B2, the teachers engaged in activities more focused on understanding than solving a problem (Gose 2014), which shows in what way they have become members of a CoRP. The boundary object seems to be variation theory as they argue about how to best design instruction based on the theoretical assumptions.

Finally, the third research question was ‘In what way can results from CoRP be transferred to enhance student learning in other CoRPs, by the mediation of a theoretical framework?’ In fact, in the internal context there were fewer contradictions, which might be a weakness. However, the increase in the students’ assessed learning outcomes showed no differences between the lessons implemented in the different contexts. The highest outcome in A was in an external group, while the highest outcome in B was in an internal group. When the students have reached a high outcome score, it seems as if the teachers instead starts to elaborate and becomes more interested in studying learning instead of teaching the students. This might be seen as one indicator of how CoRP actually develops during the projects. The teachers change perspective, maybe because of the mutual understanding of the theoretical framework. Although student learning increases can be understood as one indicator for the creation of CoRP, there were no significant differences between research communities created by teacher researchers in their own school environments and those created in other settings. This might be due to the strengths of the use of theoretical conjectures for research
in collaboration with other teachers, both at their own school and with a previously unfamiliar school and teachers, to enhance students’ knowledge and to develop teachers’ professional work based on scientific grounds. Gose (2014) argues that initially teachers try to solve a problem while researchers try to understand it, although both parts have an interest to improve practice or theoretical knowledge, instead just changing it (Langley et al. 2009). The use of a theoretical framework as a common shared knowledge seems to have served both as a guiding and boundary tool when creating CoRP. The teachers have focused on how to elaborate aspects of the content in the learning situation to offer students discernments, and in what way different handling gives differences in learning outcomes – teaching for learning instead of teaching for grading.

Acknowledgments
We also thank all participants for their contribution to the study, as well as Professor Emeritus Ference Marton, University of Gothenburg, for valuable comments throughout the entire project.

Disclosure statement
No potential conflict of interest was reported by the authors.

Funding
This work was supported by the Swedish Research Council [project number 2011-5273] and the University of Gothenburg.

Notes on contributors

Mona Holmqvist has a position at the Faculty of Education at Malmö University, Sweden, as a professor of Educational Sciences and Chair of Education and Special Education. Her main research interest is studying content area learning and teaching in classroom environments, and teachers’ pre- and in-service education.

Heléne Bergentoft is a doctoral student in Sport Science at the University of Gothenburg and a teacher in Physical Education at secondary school. She has a Licentiate degree in Pedagogical Work. Her main research interests are Physical Education teaching and teacher development.

Per Selin is a lecturer in Borås, Sweden and teaches Swedish and English as a foreign language at secondary school. He has supervised several teacher development projects concerning learning and assessing in a classroom environment. His main research interests are classroom studies and teacher development.

ORCID

Mona Holmqvist http://orcid.org/0000-0002-8734-1224

References


