Tension resolution as pattern for practice transformation in interdisciplinary teamwork in professional development

Patrick Sins
Research Centre Learning in Interaction, Faculty of Social and Behavioural Sciences,
Utrecht University, PO Box 80410, 3508 TC, Utrecht, The Netherlands
p.h.m.sins@uu.nl

Abstract: A central interest in developing professionalism resides in the potential for professionals to learn from and with one another in ways that support transformations of their knowledge practices. However, negotiation between multiple perspectives, interests, practices and traditions intertwines cognitive-epistemic with socio-relational and affective aspects, which may lead to tension and conflict. While tension can disable learning, this paper argues that identifying these tensions should be viewed as a significant source for change and development. The paper reports on a teacher-researcher collaboration at a secondary school which focuses on the co-design of a learning module. It is shown that the identification of tensions during meetings helped participants to focus their efforts on the root causes of problems, which led to a reconceptualisation of the current work practices. This subsequently helped team members to deviate from established norms and improve their practices.

Introduction

Rapid changes in current networked society present new challenges to human competence and flexibility. Productive participation in knowledge-intensive work requires that individuals, their professional communities, and their organizations develop new practices, advance their knowledge and their understanding as well as produce innovations. This is reflected in developments in professional communities wherein work is increasingly focused on the deliberate advancement of knowledge rather than on the mere production of material objects (Bereiter, 2002; Paavola & Hakkarainen, 2005). In order to cope with the cognitive, social, and motivational challenges of knowledge-based society, tools and pedagogical methods are needed that open up opportunities for enduring and sustained transformation of professionals' knowledge practices.

Based on the works of Engeström (1987), Schatzki (2002) and Reckwitz (2002) we define a knowledge practice as follows: *a social-historically created and shared behavioural pattern consisting of an interconnected and inseparable array of recurrent activities, conventions, rules and norms that play part in the creation of knowledge artefacts.* According to this conceptualization, practices are characterized by their social nature, which means that practices are shaped by and evolve within a knowledge community, ultimately becoming part of the its identity. In addition, the concept of knowledge practice entails stability as well as change. Stability is reflected as routines, procedures, conventions, underlying beliefs and values, epistemological conceptualizations and the set of available tools. At the same time, practices are open to change in that each activity based on this practice is adapted in response to changing contexts and particular circumstances.

The rationale for practice transformations is that newly developed practices and tools aim to overcome the tensions a particular knowledge community identified during certain events in their knowledge work. Practice transformations involve fundamental changes in views, beliefs, ideas and ways of working with knowledge that fulfil a certain need that is relevant for a particular professional community's knowledge work. These transformations lead towards historically new types of practices based on collaborative, tool-mediated knowledge production that takes place as long-term, sustained processes and which ultimately lead to a reconceptualization of the object and motive of the community's knowledge practices to embrace a more diverse horizon of possibilities than in the previous practice.

However, practices are difficult to change, not only because this would imply a negative evaluation of previous socially grounded practices, but also because such transformation involves a period of disorientation while old practices are gradually unlearned and new practices are gradually developed (Eraut, 2004). During this period professionals feel like novices, but without having the excuses or discounts on performance normally assigned to novices. The pain of transformation lies in the loss of control over one's practice when one's tacit knowledge ceases to provide the necessary support; and the emotional dimension is also of considerable importance. In addition, Little (1990) reports that professionals view transforming practices as involving high transactional costs to participatory work in time. According to Argyris and Schön (1978) the central problem for most professionals is that they are intellectually and emotionally committed to espoused theories which describe the world as they would like it to be, but which do not necessarily accurately describe their own activities and constrain possibilities for transforming their practices. Moreover, practices are similar to physical infrastructures

in a sense that when everything is working well one does not pay attention to them. Consequently, professionals rely on them even they are not fully aware what constitutes them. Additionally, the practices have been evolved during a long period. According to these authors, these problems can only be solved when professionals step outside their taken-for-granted world and espoused theories to actively search for genuine feedback which challenge the outcomes of their activities.

Although practices tend to remain stable and to reproduce socially shared knowledge, this stability is altered as internal or external disturbances produce various forms of tensions within activity systems (Engeström, 1987, 2007; Hakkarainen, Palonen, Paavola, & Lehtinen, 2004). The notion of developmental tensions as a driving force of change and development is drawn from the premises of cultural-historical activity theory (CHAT) (Engeström, 1987; 1999). CHAT draws upon the works of Heidegger (1962), Dewey (1968) and Leont' ev (1981) converging on the role of tensions and their resolution as a means of revealing the nature of the world around us. In these socio-historical approaches to learning and knowledge, tensions are conceptualized as the conditions that open up opportunities for creative efforts in activity and communication and are as such the driving force behind innovative knowledge practices.

Changes in practices are due to external as well as internal disturbances. According to Engeström (1999a; 1999b), identification of tensions in an activity system helps learners to focus their efforts on the root causes of problems. Barab, Barnett, Yamagata-Lynch, Squire, & Keating (2002) corroborate on this in arguing that tensions and their resolution helps to identify the dynamic forces of change and comprise an important constituent and starting point for investigating such processes. The mechanism behind tensions resolution is that as the tensions of a particular activity system are aggravated, some individual participants begin to question and deviate from its established norms. Learning is accomplished when tensions lead to a reconceptualization of the object and motive of a particular activity to embrace a more diverse horizon of possibilities than in the previous activity. While practices might change when new tools become available or circumstances and contexts shift, they can also be deliberately altered by those carrying out the activities when they invent new strategies of working or activities. In addition, members of a community may experience difficulties in constructing a connection between the goals or their actions and the object and motive of the collective activity, which may give rise to tensions.

For instance, knowledge communities that involve cross boundary practices between different domains of knowledge embody an epistemic collision of activity systems which generates disturbances and conflicts. This involves that in collaborative contexts, negotiation between multiple perspectives, interests, practices and traditions intertwines cognitive-epistemic with socio-relational and affective aspects, which may lead to tension and conflict. As practices inevitably change when concrete activities are carried out, the development and transformations of practices proves to be an ongoing and contingent process. Due to this dynamic nature of practices, the design of a new object might overcome shortcomings of former existing objects, but when they are employed as tools this will restructure the nature of the current practices and will in this manner create new opportunities but also new problems and challenges. According to this line of reasoning, learning or development of practices occurs when members attempt to negotiate about how to adapt their knowledge practices as a results of these disruptions feeding into the shared object.

In general, what is important here is that a group of professionals has to capitalize on the multiple perspectives of its members, that the group creates ownership and commitment towards achieving the common objectives and that members build up on each other willing to learn from tensions. The way to overcome these tensions is to negotiate possible solutions or design hypotheses for new practices or new tools. Eventually these new practices and tools lead to new tensions which leads to an iterative sideways movement. Preconditions for groups to be able to solve tensions to improve their practices are: 1) proactive and continuous creation of common ground, 2) sharing tensions in considerate ways and 3) supporting and recognizing agency (Matusov, 2001). However, what is still lacking in socio-historical accounts and studies of tension resolution as conditions for practice transformations to occur, is a description of patterns of tension resolution that lead to productive changes and development. Moreover, the investigation of trajectories of tension resolution affecting the emergence of new knowledge practices located at several timescales and places has rarely been touched upon in empirical endeavours.

In the present paper, we will present the data of a study in the field of a school-university partnership at a secondary school which shows a particular patterns in the cognitive-epistemic consequences and resolution of tensions. This study focused on the investigation of the practice changes of an interdisciplinary team which focused on the redesign and implementation of a learning module. Meetings of this team served to reflect upon and analyze teachers' prevailing practices, as well as envision and implement changes to the module.

The Setting and Knowledge Practices of the Investigated Knowledge Community

This study focuses on describing the nature and scope of transformations in teachers' coaching practices that followed from resolutions of developmental tensions that arose in an university-school partnership. This

partnership involved the 2-year lasting collaboration at UniC, a secondary school in Utrecht in The Netherlands that was aimed at the redesign of a course module based on knowledge creation principles (Paavola & Hakkarainen, 2005). One central feature of the knowledge creation approach that was taken up in the design was the concept of *mediation* which means that students' activities are directed towards the collaborative creation and advancement of shared knowledge objects (e.g., documentaries, research reports or instructional material) mediated by specific supporting technological or conceptual tools.

At UniC, students are coached towards the national school exam, complementing the focus on knowledge acquisition by stressing development of competencies, skills and personal development. By clever organization of compulsory learning materials students are enabled to develop their own talents and interests in a course module in which they plan and perform projects within or outside of the school context. This means that every week in the curriculum a half day is reserved for these projects for periods each of which last eight weeks. The school supports the students and offers possibilities to carry out their projects.

Within this pedagogical context, teachers' coaching practices traditionally focus on the development of courses and assignments providing guidance to students' self-directed learning process. UniC expressed the aspiration to challenge their students more towards meaningful learning. In addition, the teachers' expressed that their role during these projects was unclear and that they needed more scaffolds to structure their coaching. Therefore, a multi-disciplinary team consisting of educational researchers, teachers, students, dean, process coordinator and pedagogical experts was set up to flesh out the design based on knowledge creation principles which matched UniC's general pedagogical approach and objectives. The collaborative design, implementation and testing of the new course module implied that high demands were placed on coaching practices of the teachers which provide a platform for tensions to arise. For instance, they had to: (a) comprehend the theoretical principles behind the knowledge creation metaphor, (b) apply these principles in their practice, and (c) reflect on their role as a teacher and transform their practices accordingly to scaffold students' knowledge creation processes.

Method

Multiple, intertwined methodological approaches and various approaches to data collection and analysis were combined to elaborate dynamics of incremental changes which reflect practice transformations resulting from patterns of tension resolution. The study involved ethnographic analyses with participatory observation, a developmental intervention approach, interviews and event sampling to follow the processes towards new practices. Our analyses took tensions in partners' activities as a point of departure. We look for episodes in the material that express problems and materializes as developmental tensions.

Then we can investigate discursive activities between partners (micro level), elaborate on episodes of tension resolutions over time (meso-level) and examine how patterns of tension resolution relate to transformations of practices at the level of trajectories (macro-level). This gives to transformation processes as they play as professionals deliberately extending shared knowledge and mobilize knowledge types embedded in the social practice in their problem solving. For framing the analysis we developed the following approach:

1. Description of the knowledge practices of the investigated professional community;
2. Description of the nature of tensions that occur in these practices. Explore resolutions to the tensions, characterize tension-resolutions and analyze how these contribute to transformation towards new practice over time;
3. Examination of practice transformation including emphasizing the vertical (socialization and internalization) and/or horizontal dimension (boundary crossing and externalization).

The cases in this cluster examine the nature of these tensions that provide an important starting point to explore change and development of knowledge practices. To assess the knowledge practices of the actors involved both studies, we combined data collected from different instruments, namely:

- Material artefacts, such as reports, concept maps, and written comments;
- Pre- and post questionnaires;
- Semi-structured interviews;
- Transcribed recordings and minutes of the meetings.

These instruments were mainly designed to capture critical events during the meetings and to discern how these events are echoed in the ways professionals adapted their practices. Critical events were conceptualized as articulations of developmental tensions and were posteriori checked with the investigated knowledge communities.

Results

Most tensions were observable on the boundary of the intersecting activity systems showing how team members balanced institutionalized or traditional and newly developed practices. One source for tensions involved the specific organization of teachers' coaching practices to be more in line with the new pedagogical approach and at

the same time foster students' knowledge construction processes. The following excerpt exemplifies this tension during an interview with one of the participating teachers:

1	Teacher3	I see that an increasing amount of student groups do not have a clear view of what they are doing, that is what I am afraid of, unfortunately
2	Researcher1	How do you coach these students then?
3	T3	Well, you cannot just leave them, than this would lead to chaos. […] You can divide tasks in the group and think of who is going to do what, but then I would be too directive and I am not sure whether that should be our intention, so therefore I give them more freedom […]
4	R1	[…] Well you mean that you are still in search of what is expected of you as a teacher. What do you need in your coaching?
5	T3	First I need to know more about knowledge creation, what the idea and what the pillars are, so I can eventually adapt my coaching to that […] normally I am very clear in my teaching, but in this pilot it seems that you have to discover what the best ways of coaching are

Interview Teacher 3; December 2006

Teacher3 expresses his concern about his impression that students have not been successful in organizing and structuring their work. When prompted for his ways to cope with this impression in his coaching, he states that he would like to be more directive, saying " .. you can divide tasks in the group" (passage 3). He identifies a tension with what he interprets as the coaching practice which would comply with principles of knowledge creation" but then I would be too directive and I am not sure whether that should be our intention, so therefore I give them more freedom" (passage 3). Eventually, for him to overcome this dilemma, more guidelines for coaching knowledge construction are needed.

Thus, this episode points to a tension between what can be interpreted as top-down instruction at one hand and social distancing at the other. Teacher3 was reluctant to interfere with students' activities too much, since this would be in conflict with his emergent perspective about what is important when fostering students' knowledge construction. Still, this coaching practice added to the problem of students, who reported that they sometimes experienced their teachers' approach as being disruptive in the context of their activities:

Researcher3	What do you think of your teachers' coaching?
Student1	Well, sometimes teachers ask us just too often what we are doing and what our end product will be; what we want to achieve. But in most cases, we had explained that seven times already and they still want us to explain it even further, while we even do not yet know how far we can go, that is quite annoying

Interview Student group 4; December 2006

In this episode student1 reflects on their teacher's approach, mainly involves asking explanatory questions about the nature and status of the group's activities. This is corroborating on what teacher3 stated in the previous episode. Although teacher3 adopted this coaching practice as his interpretation of what is needed to foster students' knowledge construction processes, this caused a conflict with the observed and experienced processes of teachers and students. This point was explicated during a subsequent plenary meeting of the design group:

1	Teacher3	[…] Well, it seems our students do not have a clear idea of what they have to do
2	Dean	Students have to know what the assignment entails […]
3	Ped. Expert	[…] So I would suggest that the teachers can focus on helping to students create these structures. […]
4	Researcher3	Students could concretize their ideas in a plan
5	T2	So I would like to coach them to make it clearer like what the object is and its requirements. So far, we have maybe been too reserved.
6	PE	That is very important, and then those group members will follow their own work structure. […]
7	R2	Still, it is not a bad thing that it going like this, if they first muddle a little, […]
8	PE	But you shouldn't let that continue too long
9	T1	But, what you see now. That we should give a little more

		structure
10	T2	We can ask students to make a so-called Tabasco planning which they are already used to construct. In this planning they have to specify the activities they are going to perform, what the end objectives are. This can serve as a tool for teachers to monitor students' progress without being too directive or strict […]
11	Process coordinator	And you could revise this planning, which makes leaves it more open for students […]
12	T2	Apparently that is needed
13	R3	So, it is our observation that that is needed, yes.
14	T2	Well, that is clear by now. This shows that a good start is necessary. There has to be concrete object and once that it is there, it will go well

Protocol meeting design team; January 2007

This episode shows the identification of the issue that is at hand ".. it seems that our students do not have a clear idea of what they have to do" (passage 1), leading to an expression and framing of the tension between teachers' current approach ".. So I would like to coach them to make it clearer like what the object is and its requirements. So far, we have maybe been too reserved" (passage 3), and the more directive approach ".. But, what you see now. That we should give a little more structure" (passage 9). The suggestion that is put forward to overcome this tension is to synthesize both perspectives in a concrete manner, ".. We can ask students to make a so-called Tabasco planning which they are already used to construct" (passage 10). This is accepted and taken up by the others ".. apparently that is needed" (passage 12).

Another issue related to teacher's 3 concern regarding the lack of guidelines for coaching students' knowledge construction, and the contribution and roles of the members of the design team in the coaching practices:

1	T3	Nevertheless, it is important get more assistance during work sessions because now we're only with the three of us,. that is my first concern
2	D	It should be fixed then, we need teachers for this class […]
3	T1	Sometimes you [Researchers] are a little blunt It is not criticism but I noticed that you have you own agenda You don't really help us coach, we just have to take care of it. In my opinion that is not really being an actor!
4	R1	Well, the idea was that we didn't want to participate as a teacher because we don't have that expertise though we are here to provide you with some advice and answer your questions, if you have any
5	T1	[…] I am teaching the knowledge creation project on my own which is not an ideal situation, I just want you to think with me. Clearly we don't expect you to teach […]
7	R1	Well, I believe that is a good thing to hear, I am glad that this came forward
8	PE	The researchers are used to stay in the background to be able to observe the process as objectively as possible
9	T2	There is a big culture difference because we are used that everyone is involved You are think as observers
10	PC	It is a type of participation when you are observing […]
11	T2	You could divide one group into two groups so that T1 has to coach his own groups but that T4 and T1 meet each other during class to discuss any problems or to ask each other for advice
12	D	You can then also ask researchers for feedback during coaching […]
13	R1	Yes, that would be perfect [everybody agrees]

Protocol meeting co-design team; January 2007

This episode shows a tension between the work traditions of researchers at the one hand and teachers at the other. The issue that was expressed "..it is important get more assistance during work sessions because now we're only with the three of us" (passage 1), opened up for explicating the underlying conflict between the perspectives of researchers and teachers regarding their role during the coaching of students' knowledge creation processes. Utterance s such as "..You don't really help us coach, we just have to take care of it. In my opinion

that is not really being an actor!" (passage 3) versus "Well, the idea was that we didn't want to participate as a teacher" (passage 4) illustrate this tension. Subsequently this resulted in a framing of these conflicting perspectives from the view of the traditional work practices of both groups to create common understanding ".. There is a big culture difference because we are used that everyone is involved You are think as observers" (passage9). Eventually, partners provided suggestions to overcome this tension by a division of labor ".. You could divide one group into two groups […] you can then also ask researchers for feedback during coaching" (passage 11).

The abovementioned developmental tensions set the stage for collaborative analysis and for the creation of a shared understanding to overcome them and change teachers' coaching. Eventually, teachers' coaching transformed towards an increasing emphasis in the collective construction of a planning together with students. This would help students to organize their work and offered teachers a tool that enabled them to monitor students' progress during knowledge construction:

Phase 1 in coaching knowledge creation

- Do students have a clear plan?
- What are they eventually going to show, what is their object?
- The teacher has a specific role in this process
- 'Go' or 'no go' decision

Slide taken from presentation of Teacher3; March 2007

In this artefact, i.e. presentation provided to other teachers at UniC, teacher3 shows that that the significance of a "planning" is echoed in teachers' coaching practices. This theme can be traced from the tension that team members identified and attempted to overcome earlier. Moreover, teacher3 took up this idea and implemented a 'go-no go' decision in his practice. Then students had to negotiate their planning with their teacher before they were allowed to continue with their knowledge creation projects:

R3 How do you see your role as a teacher now, what is most important?

T3 Well. First that students chose a subject and that they construct a planning. And the task of the teacher is to perform a reality check and argue whether students' planning is a good one or not, to give a 'go' or 'no go' decision at the start. There is where the teacher plays an essential role and this planning gives a good tool for me to observe what is happening and to ensure that students keep in a 'flow' towards the end

Interview Student group 4; December 2006

In this excerpt, teacher3 reports that he had adapted his coaching to such an extent that he now asks his students to construct a planning and that it is the teacher's task to decide whether students can continue in pursuing their knowledge construction according to this plan or that they have to construct a more realistic or challenging planning.

Tension resolution of conflicting perspectives about division of labor between members of the design team resulted in creation of a joint venture agreement:

For Utrecht University this agreement involves:

- To perform research at UniC in collaboration with teachers and students concerning the concept of knowledge creation and support thereof
- To realize a long-term relationship between research and educational practice, in which knowledge, insights and experiences are exchanged with the aim of learning and capitalizing from each other

For UniC this agreement involves:

- To obtain more insight and tools to experiment with possible solutions for the challenges and issues which structurally occur in educational practice
- To realize a long-term relationship between research and educational practice, in which knowledge, insights and experiences are exchanged with the aim of learning and capitalizing from each other

Join venture agreement, first version; April 2007

Conclusion

A central challenge in transforming practices of teachers resides in potentials for teachers to learn from and with each other in the work place as they create and advance shared epistemic artefacts relevant for transforming their knowledge practices. To advance our understanding of such processes in teachers' practices, we must explore how these practices evolve. This study focused on developmental tensions between members in university-school partnership, and how their resolution points to practice transformations.

The findings illustrate that interaction between different knowledge trajectories occurred on both the individual and collective platform of the design team and how participants stabilized out of flux by changing their practices accordingly. During meetings practical pedagogical enacted knowledge of teachers intersected with social practices of the educational researchers. At this level, developmental tensions surfaced on the nexus of perspectives, agendas and interpretations of the actors involved in the collaborative design in the university-school partnership. The attempts undertaken to overcome the identified tensions involved the creation of artefacts (e.g. the joint venture agreement) that serve to objectify and afford this transformation.

Tacit knowledge (represented as the network of implicit epistemological beliefs, attitudes and knowledge) was explicated during group meetings and ideas expressed were often taken up by the group and integrated within existent practices, or became the driving force behind the development of relatively new pedagogical practices. For instance, the tension between top–down instruction versus social distancing and differentiation of coaching styles was resolved by a collective envisioning and fleshing out of coaching practices. More specifically, more emphasis was placed on employing students' planning as tools to monitor and to scaffold students' knowledge creation.

In sum, the study shows the transitions observed from identification of tensions, the attempts to overcome them by engaging in transformation of coaching and of social practices towards the creation of artefacts that serve to objectify and afford this transformation. Based on socio-historical perspectives on learning and development, we have appropriated the notion of developmental tensions as a driving force of change and development. Although we do not claim that developmental tensions are the sole impetus of transformations of work practices, the investigation of tensions and their resolution helps to identify the dynamic forces of change and comprise an important constituent and starting point for investigating such processes (Barab et al., 2002; Engeström, 1987; Koschmann, Kuutti, & Hickman, 1998; Murphy & Rodriguez-Manzanares, 2008). For the research reported here, the identification of these tensions provides a starting point for investigating and explaining practice transformations in knowledge creation contexts.

Based on the findings reported in this paper, we have derived a generic pattern of managing or resolving tension, namely: identifying, labeling, framing and solving/suggesting:

1. *Labelling the issue:* Often, tensions are not about the issue at hand (e.g., scheduling a meeting) but rather about what it represents, such as the experience of disrespect or the illegitimate exercise of authority. A tension could only arise as the consequence of one of the professionals in the knowledge construction work to describe a particular problem at hand;
2. *Identifying the tension:* as a result of professionals knowing what the issue is at hand, the contradictions in perspectives, knowledge, attitudes or affects come to the fore explicating the problematic features of the practices under scrutiny. These tensions are explicated in the voices of the several professionals in the collaborative knowledge construction work;
3. *Framing the tension:* subsequently, the tension is framed employing the self-created language, norms and rules of the knowledge community. This framing is necessary for creating a shared understanding of the tension and for constructing a representation of the forces acting in preserving and causing the problematic practices at hand. This will eventually enable professionals to adapt their practices to be able to overcome the tension;
4. *Constructing solutions:* Finally, professionals transform their or shared practices, construct new tools and implement them in the ongoing knowledge construction work.

In future research this generic pattern for tension resolution will be tested in other pedagogical co-design settings.

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