TOWARD A TRIALOGICAL APPROACH TO LEARNING

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ABSTRACT

The purpose of present article is to introduce the trialogical approach to learning that is the foundation of Knowledge-Practices Laboratory (www.kp-lab.org) project. With this approach, the present investigator has examined how educational and professional communities, supported by collaborative technologies, develop shared epistemic artifacts in long-term processes, in which knowledge creation and transformation of social practices take place in parallel, indeed, in an integrated fashion. I will contrast the trialogical framework with prevailing monological (cognitive) and dialogical (situated cognition) approaches to learning. Six characteristics of the trialogical approach to learning and are distinguished: 1) focus on shared epistemic objects, 2) sustained and long-standing pursuit of knowledge advancement, 3) interaction between personal and collective knowledge advancement, 4) cross-fertilization of knowledge practices, 5) development through transformation and reflection, and 6) flexible technology mediation designed to elicit object-centered activities.

Introduction

There is an intriguing interplay between technological and social innovations (Perez, 2005). When a revolutionary combination of technological innovations emerges, it is usually followed by intensive investment in technology implementation and creation of the required novel infrastructure. This phase is characterized by a tension-laden mixture of ill-founded technology ‘hype’ and a strong tendency to apply new technologies within the prevailing institutional practices. After such illusory hopes break down, a qualitatively different phase emerges that is characterized by extensive application of the novel technologies across all domains of societal activity as well as transformation of existing institutional practices according to the novel possibilities of the emerging new technological infrastructure.

The present investigator and his colleagues have extensive experiences with educational technology projects in the Helsinki area (Ilomäki & Hakkarainen, 2002; Lehtinen, Ilomäki, & Hakkarainen, 2002), on the national, and the European level. These experiences indicate that the first wave of implementing and using ICTs in education in 80s and 90s was characterized by gradual computerization of traditional forms of learning and instruction. Movement toward the later, transformative phase of educational use of ICTs happened in developed countries around the turn of millen-

1 Some of the ideas presented rely on Hakkarainen, Engeström, Miettinen, Sinko, & Virkkunen, 2008.
nium. This on-going phase involves substantial re-defining and re-shaping of activities of educational institutions with the help of ICTs. Instead of taking the school and its functioning as a given object of development, the challenge appears to be to radically re-conceptualize what school and learning are all about, redefine the boundaries of school and community, and explore expansive possibilities of educational transformation in practice. Social practices prevailing at school do not, however, transform very quickly; the process of merging ICTs with practices of learning and instruction as a new instrument of activity is a developmental process with its own dynamics (Vérillon & Rabardell, 1995; Béguin & Rabardel, 2000).

The purpose of this presentation is to examine such possibilities of expansive school transformation by examining a novel conception of learning which is called *trialogical inquiry*. I will start this examination by contrasting three metaphors of learning; the knowledge-acquisition metaphor, the participation metaphor, and the knowledge-creation metaphor. The division between the knowledge-acquisition and the participation view, that is highlighted by Sfard (1998, see also Lave & Wenger 1991; Wenger 1998) is very profound and depicts two fundamentally different approaches to learning. As I interpret them, the former examines learning as an individual mental process and the latter accounts it in terms of transmission of cultural knowledge and competence, from one generation to the next. The present investigator has proposed, together with his colleagues, that in order to overcome the dichotomy between these approaches, a third metaphor of learning is needed that addresses learning related to deliberate advancement of knowledge and expansive transformation of social practices (Paavola, Lipponen, & Hakkarainen, 2004; Paavola & Hakkarainen, 2005).

These issues are not only academic, but relate to the challenge of global education to devise ways to prepare learners to engage in intensive work focused on deliberate knowledge advancement (Hakkarainen, Palonen, Paavola, & Lehtinen, 2004) through evolving forms of collaborative teamwork and sustained knowledge sharing and creative advance. Toward that end, the present investigator’s research centre is coordinating the Knowledge-Practices Laboratory project (see [www.KP-Lab.org](http://www.KP-Lab.org)); this integrated EC project is focused on developing “trialogical” technologies aimed at facilitating innovative practices of working with knowledge (“knowledge practices”) in schools and workplaces (Hakkarainen et al., 2006). The project aims at creating a theoretical framework that assists in conceptualizing, empirically studying, and facilitating knowledge-creating learning in education and workplaces. KP-Lab is focused on research and development of software tools to support spatially, socially, and temporally distributed participation in learning and knowledge work, in a situation facilitative of ‘objects’, both conceptual and material. It includes extensive research training, the participation of tens of professors and hundreds of months of graduate and doctoral students’ work representing 22 organizations from 14 European countries.

**The Knowledge-Acquisition Metaphor (subjective)**

The *knowledge-acquisition metaphor* examines knowledge as a property or characteristic of an individual mind. An individual is the basic unit of knowing, and learning is a process in which information is transferred to the individual agent. The acquisition metaphor may be based on the traditional assumption of the direct transmission
of knowledge to the student, or, as Sfard (1998) herself emphasizes, the active and “constructive” (but individual) process. This metaphor leads to an examination of learning from the perspective of a student’s internal information processing and emphasizes the role of within-mind knowledge structures (e.g., schemata) in learning. Some versions of the knowledge acquisition metaphor are based on the “folk” psychological, metaphoric assumption that a person’s mind is a container, a kind of file cabinet for knowledge; learning fills the cabinet (compare Bereiter, 2002).

Figure 1: The knowledge-acquisition metaphor examines learning as an individual and mental process. The human mind is considered as a container or archive that is filled in with knowledge. This approach is focused on examining learning as monologue within mind (subjective).

The Participation Metaphor (inter-subjective)

An alternative approach, according to Sfard (1998), is the participation metaphor for learning, which examines learning as a process of growing up and socializing to a community, and learning to function according to its socially negotiated norms (Lave & Wenger 1991; Brown, Collins, & Duguid 1989). Participation in various cultural practices and shared learning activities structures and shapes cognitive activity in many ways. Cognition is distributed across individuals and their environments, and learning is ‘located’ in the evolving networking relations. From the participatory perspective, learning is the process of growing to become a full member of a community, in which there gradually occurs a shift from peripheral to full participation. From this perspective, knowledge is not within the mind of an individual, it is simply an aspect of cultural practices (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). The focus of the participation view is on activities and ‘knowing’, rather than products (i.e., ‘knowledge’ in the traditional sense).

Neither one of these metaphors appears, however, to be adequate to understand processes of knowledge creation and advancement that are essential to an advanced knowledge society. The knowledge acquisition metaphor presupposes pre-given structures of knowledge that an individual student is directed to assimilate or construct in the process of learning and expertise development. Although this process may include creative elements and support the formation of new meaning connections, the creation of knowledge is not central to this metaphor. The participatory metaphor, in turn, fo-
cuses its attention on controlling the deepening knowledge of a community without intentional aspirations to bring about conceptual or social change. Because the focus of the metaphor is on prevailing cultural practices, it does not pay particular attention to the creative change of these practices, nor focus on how shared, concrete objects are developed collaboratively in long-term processes. The acquisition approach and the participation approaches are not incapable of handling innovation, but it is a problem for them (Paavola et al., 2004).

Figure 2: The participation metaphor examines learning a process of growing up to a community and learning to function according to its norms and value. This approach highlights transformation from peripheral to central participation as well as here-and-now dialogue between participants.

The Knowledge-Creation Metaphor (objective)

I have postulated, together with Sami Paavola, that a third, knowledge-creation metaphor of learning is fruitful to overcome the dichotomy between the acquisition and participation approaches in order to help answer the challenges of the emerging innovation-driven knowledge society (Paavola, Lipponen, & Hakkarainen, 2004; Paavola & Hakkarainen, 2005). From the perspective of knowledge creation, learning is seen as analogous to innovative inquiry through which new ideas, tools and practices are created, and the knowledge being developed is significantly enriched or changed during the process. Pursuit of innovation appears to be based on social practices of knowledge communities, whose participants continuously re-invent their prevailing epistemic practices (Knorr-Cetina, 1999).

We consider the present knowledge-creation approach to be trialogical in nature because it foregrounds the objects than mediate the participants’ personal and collective epistemic activities. The participants are guided to externalize and objectify results of their inquiries in shared knowledge objects, which they can utilize in their subsequent inquiries. There are several kinds of objects that are, in the process of in-
Inquiry, transforming from one to another form. These involve digitally or textually represented conceptual objects, such questions, theories, and designs, which guide the inquiry process. Such ideas are explored by giving them a material form as prototypes or concrete products (material objects). The participants’ activities are structured by various projects and events organized that may be considered as “broader” process objects toward which collective activities are oriented. The participants’ intellectual resources and their agency coevolve in sustained and deliberate processes of working with a growing network of trialogical objects. We emphasize that ‘objects’ are not pre-given, or simply discovered; they are in process, i.e. are being formed subject to constraints; they undergo iterative development, i.e. are successively approximated. We further say that the objects are “mediating”, which means that objects serve to interconnect knowledge processes, persons, and communities. Table 1 presents an abstract description of some principal features of the three metaphors of learning.

Figure 3: Knowledge-creation metaphor addresses sustained processes of advancing shared objects of activity. Knowledge-creating learning has become accessible to educational institutions at the advent to technology-mediated learning environments that elicits systematic collaborative knowledge creation. The process is considered to be trialogical in nature because it takes place in interaction between personal and collective efforts mediated by shared objects of activity.

According to Yrjö Engeström’s expansive learning theory, the object of activity determines the psychological nature of their learning. The very essence of the trialogical approach is to provide the students with experience of a similar type of complexity to that encountered by professionals, in effect, to engage the same objects as the professionals. The object of traditional educational activity is pre-set, often very narrow and constrained in terms of being related to a specific domain of knowledge.
and addressed within a few lessons. The objects are mastered by the teacher and there is usually a pre-defined correct answer expected from the student. Each student works privately for the object and efforts are seldom shared between the participants. Tri-logical inquiries address objects that are expanded, i.e., spread out spatially (breaking boundaries of classroom, creating connections with local communities or expert cultures), temporally (integrating knowledge across individual lessons, courses, and engaging in sustained processes of inquiry across cohorts of students) and epistemically (integrating textbook knowledge with authentic local cultural, professional, and academic knowledge across domains) (compare Engeström, Puonti, & Seppänen, 2003). These aspects of expansion are partially due to ICTs and collaborative technologies that—for the first time—make it feasible to collectively work with objects that extend across space and time.

Table 1. Typical Characteristics of the Three Metaphors of Learning (Paavola & Hakkarainen, 2005)

<table>
<thead>
<tr>
<th>Main focus</th>
<th>Knowledge acquisition</th>
<th>Participation</th>
<th>Knowledge creation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monological</strong> perspective (within mind)</td>
<td>An individual process of adopting or constructing subject-matter knowledge and mental representations</td>
<td>A process of participating in social communities, Enculturation, cognitive socialization</td>
<td>Individuals and groups creating and developing new material and conceptual artefacts</td>
</tr>
<tr>
<td><strong>Dialogical</strong> perspective (between participants, or towards authentic situations)</td>
<td>Cognitive theories of internal knowledge structures and schemata; individual knowledge construction</td>
<td>Transforming norms, values, and identities</td>
<td>Conscious knowledge advancement, discovery, and innovation</td>
</tr>
<tr>
<td><strong>Trialogical</strong> perspective (co-evolution of inquirers, communities, and objects of inquiry)</td>
<td>Conceptual knowledge emphasized “Know that”</td>
<td>“Dialogical” perspective</td>
<td>“Trialogical” perspective</td>
</tr>
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<table>
<thead>
<tr>
<th>Theoretical foundations</th>
<th>Tools that facilitate information delivery and provide resources for individual knowledge acquisition.</th>
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<tbody>
<tr>
<td>Cognitive theories of internal knowledge structures and schemata; individual knowledge construction</td>
<td>Situated cognition, various forms of social constructivism</td>
</tr>
<tr>
<td>Practices and social interaction emphasized; “Know how”</td>
<td>Theories concerning mediated activity (Cultural-historical activity theory, knowledge-creating organizations, knowledge-building theory)</td>
</tr>
<tr>
<td>Communities of practice</td>
<td>Transformations between various forms of knowledge; “Know why, and what for”</td>
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<tr>
<th>Perspective on technology</th>
<th>Tools which enhance social interaction and community building (chat, conferencing, social media)</th>
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<tbody>
<tr>
<td>Tools that enhance or “augment” human learning and cognition; tools for “trialogical” knowledge practices?</td>
<td>Media and transformative artefacts and tools; tools for collaborative knowledge creation and development</td>
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<td>Mediation and transformational artefacts and tools; tools for collaborative knowledge creation and development</td>
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<tr>
<th>Unit of analysis</th>
<th>Individuals</th>
<th>Groups, communities, networks, and cultures</th>
<th>Individuals and groups creating mediating objects and artifacts within cultural settings</th>
</tr>
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Six basic characteristics of trialogical learning

The overall pedagogical objective of the trialogical approach is to promote the transformation of prevailing educational practices that facilitates the development of skills and competencies of deliberate creation and building of knowledge from the beginning of higher education. We have, based on our KP-Lab studies, proposed the following, six, interrelated, principal features characterize trialogical learning.

1. Focus on shared objects of activity which are developed collaboratively (I have already described this issue).

2. Sustained and longstanding pursuit of knowledge advancement. Novelty and innovation emerge through iterative efforts taking place across extended time scales.

3. Knowledge-creation processes taking place in mediated interaction between individual and collective activities. Individual participants may have a key role in knowledge creation but their efforts are embedded on a fertile ground of collective activity.

4. Cross-fertilization of knowledge practices between educational, professional, and research communities in terms of bringing cultures of schooling in closer contact with professional cultures and engaging students in expert-like knowledge practices from the very beginning of their studies.

5. Technology mediation. There must be appropriate technologies that help the participants to create and share as well as elaborate and transform knowledge artifacts.

6. Development through transformation and reflection. Novel ideas emerge through interaction between conceptualizations and practical explorations. Crystallization of evolving ideas in shared practices and routines plays an important role in the process.

Scientific research communities, product-development teams, and other professional communities are prototypical examples of social entities aiming at focused creation of knowledge rather than just assimilating existing knowledge or adopting prevailing practices. Within rapidly evolving global knowledge society, pursuit of novelty and innovation are more and more commonplace activities that characterize all workplace communities. Students of higher education need similar and preparatory experiences (Mandl, Gruber, & Renkl, 1996). We have carried out investigations from elementary-level to higher education as follows:

- My research group has carried out a series of progressive-inquiry experiments that involve long-term pursuit of question- and explanation-driven science projects (electricity, force, cosmology) at the elementary level. A weakness of such investigations, to be reflected on later in this presentation, may be that the investigations focused too much on curricular within-classroom topics. I would like to develop such investigations toward a direction outlined by Wolff-Michael Roth; we seek to integrate of science education with students’ participation in social movements regarding strategic challenges of the humankind, such as environmental issues (Roth & Barton, 2004). Scientific literacy may be seen as a capacity of producing knowledge for solving authentic rather than mere “educational” problems. Students appropriate different and more demanding role than standard school-based activities; ordinary students who are not doing very well in regular classrooms may start excelling in the process of such activities.
Collaborative designing is a paradigmatic experience of trialogical inquiry; it is mediated by the shared design objects having both conceptual and material dimension that are iteratively developed. Together with Pirita Seitamaa-Hakkarainen, I have carried out numerous investigations focused on facilitating learning through collaborative designing (Seitamaa-Hakkarainen, Lahti, Hakkarainen, 2005; Lahti, Seitamaa-Hakkarainen, Hakkarainen, 2003). These involve the artefact and architecture projects that are introduced in her presentation as well as a series of studies at higher education focused on designing clothing for prematurely born babies, conference bags, or tactual books for blind youngsters. The project focused pursuing genuine cultural objects and involved intensive interaction between students and professionals.

Series of knowledge-practice courses, that we are organizing at polytechnics and universities within frames of KP-Lab, are designed to elicit trialogical inquiry. Rather than relying on pre-determined curricular boundaries and traditional teacher-centred pedagogies, these experiments focus on set-ups, arrangements, and patterns of interaction which elicit cross-fertilization of knowledge practices between educational and professional communities. The participants have represented multiple domains of knowledge from engineering and medical studies and from psychology to education.

Instead of merely lecturing about curricular topics, the participants’ of KP-Lab courses are engaged in projects in which they solve complex problems for real customers coming from professional communities. The participants’ activities are organized according to knowledge-intensive project work involving a) multi-disciplinary student teams pursuing knowledge-advancement objectives with personal and collective accountability; b) team leaders representing senior students who took the corresponding knowledge-practice course, c) coordination teams consisting of team-leaders who take care of negotiating with customers. Participants carry out d) intensive data collection in the wider field, e) systematic collaborative production of epistemic artefacts, as well as f) an on-going reflective evaluation of the whole process. By taking part in such boundary-breaking processes, the participants are able to contribute productively to creation of culturally valued knowledge.

Developing trialogical learning technologies

Many educational applications of ICT support currently either mere knowledge acquisition or social participation. On the one hand, the most popular pieces of educational technology, such as digital learning materials, many applications of educational multimedia, drill-and-practice applications, are designed to support information delivery and pursuit of pre-determined learning tasks. On the other hand, it is common to utilize social media for supporting either synchronous (conferencing tools, chat-environments) or asynchronous (discussion forums, networking tools) communication between students: Chatting around computers and digital artifacts may be enjoyable but does not elicit deeper learning agendas without being embedded on sustained inquiry efforts.

While the tools and practices I have described may provide educationally valuable experiences, my colleagues and I would like to emphasize the importance of pursuing research and development of technology-mediated learning environments
that are specifically designed to facilitate collaborative creation of knowledge. From the trialogical perspective, it is essential that educational technology support creation, sharing, and extending of various epistemic artifacts by the learners themselves, assist in representing and reflecting of various materially embodied activities, including field studies, and facilitate expansive transformation of prevailing practices of working with knowledge both within educational institutions and in collaboration with various local user communities.

The present investigator took active part in research and development of the Computer-supported Intentional Learning Environment (CSILE) and its current version Knowledge Forum designed by Scardamalia and Bereiter (1994; 1999; 2006). Knowledge Forum is a technology-mediated learning environment designed to facilitate collaborative knowledge building at different levels of education as well as in professional communities. It is well-known from its facilities for visually organizing knowledge. All knowledge prevailing in the collaborative space of the system is created by the users themselves.

![Figure 4. KF’s user interface. Students written notes (red squares) with digital pictures taken by students during a fieldtrip to meet a blacksmith.](image)

In addition, my research community was responsible to the pedagogical design of three generations of the Future Learning Environments (www.FLE3.uiah.fi); this groupware system was developed in collaboration with the Medialab of University of Arts and Design Helsinki (fle3.uiah.fi; Seitamaa-Hakkarainen, Raami, Muukkonen, & Hakkarainen, 2001; Muukkonen, Lakkala, & Hakkarainen, 2005). FLE is based on open source software and it is used in more than 50 countries. It provides sophisticated tools for going through knowledge-building discussion and “jam-sessions” of collaborative design in the context of university education.

Relying on experiences of such research and development efforts of educational technology, the KP-Lab’s project aims at providing software that supports spatially, socially, and temporally distributed participation in knowledge creation in educational and workplace settings. The learning system being developed will be modular in nature so that it can in a flexible way be adapted and tailored to the users needs and integrated with various external applications used by them. The system is built around a
shared collaborative space that will included tools for working with various kinds of epistemic artefacts and for managing knowledge creation processes. The system will supports visual organization of epistemic artefacts and associated inquiry processes. The users will be provided with mobile tools that allow them to document critical incident encountered in fieldwork, and tools for annotating multimedia (e.g., video recordings shot during fieldwork), and virtual change-laboratory tools for modelling and analyzing activity systems. Pilot versions of KP-Lab technologies, that will be based on open-source, have become available only in the spring of 2008.

Figure 5. KP-Lab’s shared space involving a) visual organization of knowledge objects, b) note editor, c) integrated Wiki and d) multimedia annotation tool (here used in the context of neonatal simulation at Karoliniska Universitetet).

Three generations of research on technology-mediated learning

The present trialogical approach did not come out of the blue; it emerged through 12 years of efforts to understand innovative learning processes. The research group at Helsinki has pursued research aimed at improving the quality of learning so as to answer the challenges emerging from the knowledge society in Finland, Europe, and North America. Investigations regarding the above metaphors have been undertaken in our efforts to resolve tensions or challenges emerging from our research work. In theoretical foundations and research methodologies, one may distinguish three overlapping "generations" of learning models on which our investigations have relied.

Generation 1: My efforts to promote education by facilitating expert-like working with knowledge started in 1994 when I returned to Finland from doctoral studies at the University of Toronto. In my doctoral thesis (Hakkarainen, 1998), I had developed the progressive inquiry (PI, Figure 4) model that guided students who were as-
sisted through computer-supported collaborative learning (CSCL) software. The dissertation involved a series of studies over three years in which I qualitatively analyzed the epistemological nature of 10-11 year-old students’ research questions and explanations. Initially only a minority of the students produced knowledge at a high explanatory level, but the practice spread. Further qualitative analyses indicated that knowledge produced by the CSILE class was at a very high explanatory level both in biology (2003b) and physics (2004). Student posed research questions often were explanation-seeking in nature, and larger questions were broken down into smaller ones, as occurs in scientific practice (Hintikka, 1999), scaffolding within CSILE.

Figure 6. Elements of progressive inquiry. Progressive inquiry is a process of learning driven by students-generated questions and explanations that the participants are sharing among themselves.

Our research group ran, however, into various problems while trying to facilitate conceptual change in Finnish elementary education. Finnish students were initially posing mainly fact-seeking questions and gaining fragmentary knowledge (Hakkarainen, Lipponen, & Järvelä, 2002). We were not able to convey the basic concepts of inquiry to the teachers, and the computer/software focus typically led to their becoming more interested in ICT technology than learning or understanding. Our attention was drawn to the issues of social practices and classroom culture. We realized gradually that genuine inquiry cultures do not emerge without transforming the social practices prevailing at school (Marton & Trigwell, 2000; Hakkarainen, 2003b; 2003b; 2004). The mature inquiry cultures investigated by me at very special school sites in Canada had their own histories. Even within Canada, not to say, between Canada and Finland, simple transfer was not possible. There would, for any location, have to be corresponding developmental-historical pedagogical processes.

Generation 2: These challenges drew our interest to those participatory aspects of learning that had been invisible to many cognitive researchers. Learning takes place within communities of practice (Lave & Wegner, 1991) that guide and constrain the participants’ activities in multiple ways. In order to understand these processes
better, we teamed up with innovative teachers, started videotaping classroom practices, and learned to do social network analysis (SNA, Hakkarainen & Palonen, 2003; Lipponen, Veermans, Lallimo, & Hakkarainen, 2003); this method allowed us to examine patterns of participation in our school projects and the “social infrastructures” (Bielaczyc, 2006) needed to make computer-supported learning work.

These investigations indicated the need to articulate a more general theory of knowledge-creating learning as well as to anchor the progressive-inquiry model more closely in social practices. Cognitive researchers have highlighted the importance of guiding students to take part in in-depth learning involving active processes of knowledge construction. The problem is that even if students and teachers would be aware of the desirable characteristics of such learning, this does not in itself provide a basis of making corresponding changes. This is because learners have developed, in the course of their lives, an implicit and subconscious *habitus* (Bourdieu, 1977, Roth, 2002), i.e., predisposition to act and think in certain ways at school that is carved into their minds and bodies by social practices. Because educational activity is embedded with certain kinds of habitus, its transformation is very difficult and may require tremendous efforts across long periods of time.

*Emerging generation 3:* Something was, however, still missing, and the dynamics of learning was only partially grasped. We were studying social networks and practices, but losing a relation to epistemic processes essential for in-depth understanding as well as advancement of knowledge. Currently, we are seeking to understand learning as a form of trialogical activity focused on collaboratively advancing shared objects of inquiry. Rather than mere epistemic processes, creation of innovative knowledge communities appears to rely on an integrated pursuit of knowledge advancement and transformation of the prevailing social practices. Innovation and knowledge creation appear to be about creation of social practices: Instead of rigid routines or repeated procedures, such practices are focused on constant re-creating in a way that elicits successful pursuit of innovation (Knorr-Cetina, 1999).

In order to expand investigations to knowledge practices involved in trialogical processes, one needs corresponding improvements of research method along with theoretical development. The problem of accessing and characterizing the “object” necessitated that the present investigator use multiple methods of learning research, such as participant observations, structured interviews and validated self-report instruments. The KP-Lab environment is designed to provide affordances for ‘objects’; the ‘portfolios’ or folders offered by the software have allowed us to examine, at all stages of their elaboration, sketches, photos and plans posted to the common database. Because temporally extended epistemic processes cannot be easily experimentally studied, the present investigators are engaged in developing rigorous methods of collecting longitudinal data of complex interactive processes of learning and cognition. KP-Lab project aims at developing research instruments based on 3G mobile devices for doing Contextual Activity Sampling (Muukonen, Hakkarainen, Inkinen, Lonka, Salmela-Aro, in press), based on ecological momentary assessment (EMA, Reis & Gable, 2000) and experience sampling method (ESM, Csikszentmihalyi, 1996). Thus we are collecting time-series data regarding transformations of trialogical objects worked upon as well as longitudinal changes in knowledge practices of students of universities and polytechnics.
Facilitating expansive school transformation by technology-mediated learning

Instead of examining technology-mediated learning environments as a separate sphere of activity, our current efforts based on the cultural-historical activity theory (CHAT, Engeström, 1987) focus on utilizing the trialogical approach for developing novel conceptions of schooling. The ICT-based novel historical possibilities of the development of educational activity provide the basis of interventions focused on facilitating expansive school transformation that my research centre is pursuing not only in Finland but also in Southern African (SADEC) countries. Rather than trying to directly transmit experiences of Finnish information society to the developing countries in question, we are providing the national school administrators, teachers, and local communities support in rethinking what schooling and education are all about in the age of technology-mediated learning.

The CHAT highlights importance of parallel transformation of practices and conceptualizations. Breaking the boundaries between school and external communities allow taking critical collective problems and strategic societal challenges as objects of investigations that are addressed by relying on available cultural-historically evolved tools and instruments. Figure 6 presents four ideal typical conceptions of school based on two dimensions of expansion of the traditional school (Engeström, Engeström, & Suntio, 2002).2 The first addresses the nature of problems solved and the second relations between school and the surrounding society. Across the first dimension there is a trend from solving well-defined textbook problems for which the right answer is known to pursuit of complex real-life problems that can have many justifiable solutions. The other dimension involves transformation from a school that is isolated from society toward a school that is integrated with and embedded in a close collaboration with the surrounding community.

By combining the two dimension of expansion, sector 4 defines the collective zone of proximal development of school, i.e., a dynamic zone of potential development that is based on historically emerged novel forms of technology-mediated educational activity. In such a school, learning is to a significant extent carried out by solving real-world problems in contexts that cross-fertilize educational and professional activities. Such practices may involve extensive fieldwork, interaction with local communities, or collaborative projects involving diverse stakeholders (Hakkarainen et al. 2004; Roth & Lee, 2007; Yamazumi, 2006). While taking part in such expanded activities students are likely to appropriate novel practices and more demanding role as well as develop agencies needed for productive participation in cultural communities.

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2 I am grateful for Professor Jaakko Virkkunen for making me aware of the importance of this distinction.
Expansive school transformation requires joint efforts of teachers, students, and members of the local communities. Toward that end, sophisticated interventional methodology is needed that makes prevailing practices visible, assist in evaluating evolving activity, and support deliberate pursuit of collective transformation. The present investigator is together with collaborators from the Centre for Research on Activity and Developmental Work Research, utilize Change Laboratory (CL) interventions for eliciting expansive school transformation. It is an already well-defined intervention method to support organizational and social transformations (Engeström, 2007; Engeström, Virkkunen, Helle, Pihlaja, & Poikela, 1996). CL comprises a series of meetings of a workplace community for reflecting on the historical development of activity, latent tensions and weaknesses of current practices, and planning and implementing practical changes concerning future activities. These collaborative reflections are facilitated and guided by the researchers. The CHAT methodology, also used in KP Lab, provides the participants conceptual tools for analyzing their activity and guidance in modeling the dynamic development of activity systems in question.

Expansive school development may be facilitated by initiating multi-voiced dialogue about the requirements and possibilities of technology-enhanced school. The zones of educational institutions’ proximal development may be explored through dialogues between a) between local needs and resources and national policies and b) between local experiences and challenges and ideas coming from the international scientific and professional discussions concerning expansive school transformation and educational and communal use of ICTs.
The object of such a dialogue may not only be the local development in schools, but the development a novel concept of the school through a collective invention process of participating teachers, students, schools, and local communities. When successful, such expansive processes may give birth to a radically novel type of school that focus on creating locally valuable knowledge as solutions for vital local problems by relying on an intensive school-community interaction. The present investigator and his colleagues are, simultaneously, using both top-down and bottom up approaches to school development. In top-down, we elaborate the triagonal framework and developing technology-mediated tools for supporting knowledge advancement. In bottom-up, we search for expansive possibilities for implementing our approaches through dialogue with schools and local communities.

Teacher training has a crucial role in educational transformation.

Teachers and teacher training have a crucial role in such expansive school transformation. The present investigator and his colleagues were responsible of pedagogical evaluation of the Educational Technology Project of the Helsinki City Department of Education at the turn of millennium (Hakkarainen, Muukkonen, Lipponen, Ilomäki, Rahikainen, & Lehtinen, 2001; Ilomäki & Hakkarainen, 2002; Lehtinen, Sinko, & Hakkarainen, 2001). During the project all schools were equipped with information networks and computers and several thousand teachers went through ICT training. It took, however, several years before the teachers learned to use emails and the most common productivity tools. In the end of the project, only a few teachers used ICTs regularly in preparation and conduction of their instructional activities; they integrated technological and pedagogical expertise (Ryymin, Palonen & Hakkarainen, 2008).

One of the central limitations of educational use of technology, it teachers’ tendency to function as independent professionals who seldom collaborate with one another. The emergence of collaborative technologies, however, make intellectual teamwork both accessible to the participants and necessary condition for addressing com-
complex and multi-faceted problems encountered that cross boundaries of individual disciplines. We have recently initiated pedagogical experiments that rely on Roth’s (2002) co-teaching approach; this pedagogical framework guide teaches to engage in pursuing joint projects. By taking turns of assuming responsibility of leading project activities, they are able to make, for instance, good practices of questioning visible to one another and, thereby, transform their partially unconscious and implicit teaching related habitus. Parallel working for developing models of inquiry-based teacher training and teachers’ professional development appear to be promising.

Concluding remarks

Knowledge Practices Laboratory aims at conceptualizing a framework for a theory of learning and cognition emphasizing collaborative knowledge creation in education and workplaces. *Trialogical inquiry* refers to pedagogical practices and models regarding collaborative work around shared objects. By developing and testing the emerging “trialogical” framework through a series of empirical studies, the KP-Lab project focuses on creating scientifically sound pedagogical models and guidelines for facilitating collaborative knowledge creation in different levels of education as well as in professional communities. The project relies on the assumption that educational and professional institutions should be developed towards knowledge-creation communities (Bereiter & Scardamalia, 1993; Hakkarainen et al., 2004; Hargreaves, 1999). Neither students, teachers nor professionals should be considered as mere consumers of knowledge, but also as prospective creators of new knowledge and innovative transformers of knowledge practices. They are able to collectively generate knowledge that can be used and utilized by their fellow participants as well as external communities, when appropriately assisted and engaged in iterative efforts. Toward that end, it is essential to break boundaries between educational and professional cultures, cross-fertilizing knowledge practices by bringing the complexity of real world to educational institutions (Mandl, Grüber, & Renkl, 1996).

Because knowledge advancement, knowledge creation or ‘trialogical inquiry’ require changes of the social settings in which learning occurs, I have argued for greater focus on social practices in learning institutions and workplaces. I have argued that in order to genuinely elicit educational transformations, it is necessary to put social practices into the middle rather than the periphery of discussion. Instead of mental dispositions or mere foregrounding of students’ ideas, knowledge-creating learning is about certain kinds of social practices of working with knowledge, as preliminarily explicated by the trialogical approach. Genuine elicitation of educational transformations should focus on creating shared knowledge practices that channel the participants’ limited intellectual resources in a way that elicits meaningful engagement, advancement of collective knowledge especially as regards the objects of inquiry. Pursuit of question-driven inquiry, collaborative design or boundary crossing are social practices related to creative working with knowledge. Such pedagogical approaches, labeled as knowledge building (Bereiter, 2002) or progressive inquiry, define and conceptualize a certain kind of innovative knowledge practices. These are directed to common objects—concepts, products, prototypes and procedures—and are cultivated iteratively in collaboration between practitioners (teachers) and researchers in long-term processes. To summarize, more than a decade of experience of studying computer-supported learning indicates that *technology enhances meaningful learning and instruction only through transformed social practices* (Hakkarainen et al., 2006).
REFERENCES


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