Teacher-researcher dialogue and expansive transformation of pedagogical practices

Abstract

The purpose of the present article is to examine the expansive transformation of pedagogical practices prevailing at elementary-level education. Toward that end, it addresses the dynamic interface that emerges in collaborative relations between teacher-practitioners and academic researchers. Pursuit of pedagogical innovations in the context of computer-supported learning requires interaction across the disciplinary borders that often separate practitioners and researchers in education. The article introduces the pedagogical model of progressive inquiry and describes an elementary-school students’ study project in which the model was applied by the teacher participant. Dialogues between a teacher and a researcher are used to illustrate cognitive, social and emotional challenges involved in teacher-researcher interaction, in using PI in education and in the overall pedagogical transformation that is entailed. The experiences of the project indicated that the network-based learning environment should not necessarily be considered as the space for sharing knowledge and collaborative knowledge-building. Rather, at least in the present PI project, the network-based environment functioned as a space for gathering knowledge and documenting the process of knowledge-building while the actual sharing of knowledge took place in face-to-face discussions in the classroom, i.e. in the physical space.

Keywords

Collaborative technology • knowledge building • progressive inquiry • teacher’s voice

1. Introduction: A Dynamic Interface of Teacher-Researcher Interaction

The purpose of the present paper is to describe the pedagogical transformations involved in creating a Progressive Inquiry (PI) culture in the context of computer-supported collaborative learning (CSCL). Progressive inquiry is a pedagogical approach oriented to facili-
tate collaborative inquiry-learning in general and Computer-Supported Collaborative Learning (CSCL) in particular. It has been created by Kai Hakkarainen and his colleagues in Finland (Hakkarainen, 1998; Hakkarainen, Palonen, Paavola & Lehtinen, 2004; Muukkonen, Lakkala, & Hakkarainen, 2005) on the basis of Carl Bereiter’s (2002; Scardamalia & Bereiter, 1994) knowledge-building approach. The progressive inquiry approach has become relatively popular in Finland; many schools, provincial departments of education and teacher-education institutions have made it a central foundation of their pedagogical practices. Also Finnish national curriculum guidelines acknowledge the importance of engaging students in inquiry practices addressed by this framework. While the original formulations of the model relied on cognitive research on educational practices and were, consequently, conceptually biased, the model has been developed toward a socio-cultural direction during the last five years (Hakkarainen, in press). Aspects of inquiry addressed by the progressive-inquiry model are examined as special kinds of social practices related to productive working with knowledge (i.e., “knowledge practices”).

The present investigators contend that it is essential to hear both the teacher’s and the researcher’s voices (c.f., Wertsch, 1995; Bakhtin, 1981) when one is doing research on computer-supported collaborative learning. Toward that end, the present article aims at making explicit the multi-voiced characteristics of teacher-practitioners’ and researchers’ joint efforts to improve the quality of learning and instruction with the help of collaborative technologies. Dialogues between the teacher and researcher participants are used throughout the article to illustrate the psychological, socioemotional, social and cultural challenges involved in the described pedagogical transformation. This approach enables us to address the inherently heterogeneous, conflictual, tension-laden and unstable aspects of practices of computer-supported learning taking place in Finnish elementary-level education.

While the PI model may be used in a normative manner, the present article is focused on describing the actual implementation of this approach in pedagogical practices rather than simply presenting its conceptual foundations. The model serves as a heuristic tool for reflecting on and transforming pedagogical practices, a process in which the model is further elaborated and developed dynamically; it does not simply exist in pre-set standards used to assess the teacher’s and learners’ process. Precisely because the implementation of normative models in social practices is very difficult and not a matter of static application or pre-set guidelines, we need a dialogue between teacher-practitioners’ and researchers’ perspectives embedded in joint efforts of expansive transformation (Engeström, 1987) of pedagogical practices. Educational interventions carried out by academic researchers in educational institutions appear to create a dynamic interface (compare Long, 2001) between the researchers and teacher-practitioners. The purpose of the dialogues used in the present article is to make the character of this interface evident, and in particular to reveal how multiple interests and interpretations interact and determine the course of discourse and pedagogical interventions in various and partially unpredictable
ways. We have published a monograph in Finland (Hakkarainen, Bollström-Huttunen, Pyysalo (currently R. Hofmann) & Lonka, 2005) in which such teacher-research dialogues were used to frame progressive inquiry; it was very well received by practicing teachers.

The article describes a process of moving from project learning towards progressive-inquiry practices by introducing the pedagogical model of PI and describing an elementary-school students’ CSCL project in which the model was applied by the teacher participant. The teacher participant (Marianne) is female, and she has more than 25 years experience of teaching elementary school pupils. She has specialized in using ICT in her teaching for more than 15 years. At the time of conducting this study, she worked as a provincial pedagogical support person and trainer of other teachers using ICT, being allowed to use 1 day of each week for this purpose. She is currently retired. The researcher participant (Kai) is a 52-year-old professor of education, with a professional background in psychology and cognitive science. He has been working with CSCL since 1994.

The dialogues have been constructed from transcriptions of the two participants’ interviews and their discussions. These two participants were allowed to edit their assertions so as to crystallize their ideas and improve the flow of arguments. These transcriptions have been selected from among a very large corpus of text to illustrate critical aspects of computer-supported inquiry learning and its implementation in elementary school. The last author of the present paper assumed responsibility for stylistic editing and organizing the material into the form of the present dialogues. All statements have been translated from Finnish.

In what follows, we will illustrate the emergence of a collective progressive-inquiry culture in the context of CSCL, relying on dialogues between the teacher and research participant.

**An Initial Encounter**

Marianne (M): When I heard Kai Hakkarainen talk about progressive inquiry (PI) for the first time at the summer school of the Educational Technology Project in the City of Helsinki about 12 years ago, in which he claimed its superiority over project learning (PL), I was really angry about his devastating and overwhelming criticism of the latter. I understood, roughly speaking, that while participating in PL, students do not usually achieve good learning results at all. Nonetheless, I thought that the assessment was unfair and felt that it was directly focused on my own pedagogical methods. I had just completed an excellent long-standing professional PL training course, and, encouraged by this experience, started to bring up, as a teachers’ ICT trainer and pedagogical consultant [support person] examples of students’ productions that anyone could have ‘taken as a model’.

Kai (K): When I started to pursue research on CSCL in the middle of 90s, I did not know very much about computers, schools or teachers. I was a kind of epistemologist, not in terms of being a professional philosopher, but in terms of being a student inter-
ested in theoretical questions without being really able to do empirical research. Nevertheless, I was, theoretically familiar with cognitive research on educational practices. In my first encounters with teachers I was usually assisted by one of my colleagues who had extensive experience of working with teachers. I remember one teachers’ meeting at which she let me say one sentence, then interrupted me, translated my message into a form that the audience would better understand, and then let me to continue, only to interrupt me again and so on. It was a true challenge to work out concepts and frameworks that allowed me to communicate findings of research on computer-supported learning to teachers and other interested parties. My critical stance was reinforced because I had personally had rather negative experiences of school.

M: It turned out that after recovering from your ‘researchers’ critique’ I felt a sustained new drive for my work with ICT and teaching. I have always wanted to examine things at a deeper level, and I have been frustrated by the surface-level processing of things that so often characterize school learning due to shortage of time. After listening to your lectures about progressive inquiry, I took experimenting with the method as a personal challenge, although I was not convinced about its benefits. ‘If it would allow me to obtain even better results than those achieved during my project-learning projects, it would be worthwhile,’ I thought.

K: It took a long time to learn to work with teachers and schools. Step by step I learned to find words and expressions that helped me to create contacts with practicing teachers and talk about progressive inquiry in a way that facilitated pedagogical changes as well as conveyed my appreciation of teachers’ work. I learned over time to understand better the constraints under which teachers function, and after coming to know many excellent teachers, such as Marianne, to appreciate that they often engage in incredible efforts to help students to learn. I have to admit, however, that I sometimes still succeed in upsetting teachers and I have many times decided to be more careful about watching what I say.

2. Pedagogical Limitations of Project Learning

In the following, the initial interface of the present researcher-teacher collaboration will be described. It involved critical discussion of prevailing practices of project learning and envisioning of expansive possibilities provided by the progressive inquiry approach. “Project learning” is used throughout the article to refer to concrete practices of using ICTs that were observed by the research participant; our criticism concerns these concrete practices rather than pedagogical value of project-based learning in general (about sophisticated forms of project-based learning, see Krajcik & Blumenfeld, 2006).

K: While visiting schools I noticed that project learning was a popular pedagogical method. This pedagogical approach guides teachers to use information and communica-
tion technologies for organizing student-centered projects. Although it involved many positive aspects and emphasized cooperation between students, it appeared to be too strongly focused on external activities and the production of fancy, nice-looking end productions. Parents and other visitors were invited to admire students' productions, but it remained uncertain whether in-depth learning or inquiry had really occurred. Following Carl Bereiter's (2002) arguments, I proposed that project learning focused too much on hands-on activities rather than represented extended working for the advancement of students' ideas and thoughts, which characterizes authentic inquiry.

M: I started to apply and experiment, gradually, with the PI method in practice. The course of my learning may be described as a jigsaw puzzle rather than a direct path. I imagined that PI would be easy. Pretty soon, I realized, however, that different aspects of the method involve transforming continually arising, new problems, for each of which you need to find a solution during the process. My experience was similar to that of a passionate solver of jigsaw puzzles; new puzzles consisted of an ever-increasing number of smaller and smaller pieces. Many pieces had to be put aside before the correct and long-missed piece could be found. For six years, I have struggled through several projects together with students, to learn something about the stages of PI by wondering, reading, writing, discussing, making mistakes, making observations and trying it all over again. My own learning has certainly not been easy. Only a couple of our projects deserve to be regarded as PI projects. Most of the projects have been divided into smaller problems that have been pursued by using PI methods with varying degrees of success. On the way, the projects have been transformed toward processes of inquiry.

**How Can Educational Practices Be Transformed?**

K: Change in practices is very hard for anyone to bring about, whether a teacher or a researcher. How did you succeed in going through the transformation of your pedagogical practices?

M: Learning of the method required, in my opinion, 'looking in the mirror', profoundly reassessing my earlier teaching. I went far back in time. In my mind, I went through my students' group work on the Rome topic and a multimedia production concerning Native Americans and Expeditions. Australian Animals and the Most Important Inventions (with inventors) had also been involved in our projects. I had been very satisfied with the development of students' ICT skills, and so were the students themselves. My students were among the few who were already able to use ICTs fluently in 90s, from text processing to working with digital images. I wondered and doubted whether it would have been possible to do the work any better.

K: It appears that, in your case, pedagogical and technological sophistication were productively meeting each other. Many of the CSCL teachers that I have worked with have only been interested in technology. Whenever one went to their classrooms, they
were excited about new pieces of equipment or a screensaver they had acquired; but they never talked about students’ understanding and advancement of their thoughts.

**What Do Students Actually Learn through Computer-mediated Inquiry?**

M: Everything was not, however, in order in my teaching, something was missing. I had not had time to think about what students actually learned from project work. I took it for granted that they would also learn things that they were writing about. It did not occur to me to ask whether they learned well enough or would have been able to learn better by using another method.

K: So what was the missing epistemic element? What kinds of weaknesses in your students’ epistemic efforts did you find after examining your work critically?

M: I realized that most students’ own ‘mental’ contributions had been too narrow and small. They had learned ICT skills, written a lot of texts using computers, and produced pictures in multiple ways, but most of the work had consisted of taking material found from a source, putting it in a slightly modified form and posting it to a multimedia environment. Copying things from information sources by using computers was not meaningful. Students did not remember more than they would have learned by copying things into their ordinary notebooks. We would have needed other kinds of methods for keeping things in mind and working through them. Everyone learned, from a complex unit, mainly about his or her own topic. Our shared attention focused on the impressive appearance of the work. It was technically really excellent collaboration from the whole class. I started to realize that I could survive by teaching computer skills to the students whenever those were needed, so that it was not necessary to focus on this so much. I observed that the use of ICT calmed down some pupils who were difficult to control in conventional classroom situations. For one of the students, ICT was the only way of engaging him in task-related activity.

3. Progressive-Inquiry Model – An Implementation of Knowledge-creation Perspective on Learning

K: It turned out to be necessary to concretize philosophical ideas of inquiry that I was interested in into a pedagogical model. Even if limited, the Progressive Inquiry Model, developed together with colleagues, such as Kirsti Lonka and Lasse Lipponen, allowed me to talk in concrete terms about pedagogical transformations that we wanted to bring about in education with the help of CSCL. We wrote a book together (Hakkarainen, Lonka & Lipponen, 2004) that sold more than 15,000 copies in Finland; this is pretty exceptional. The model did not emerge from scratch; it is an abstraction of actual learning processes, for instance, those in which 10-year-old Canadian CSILE (Computer-Supported Intentional Learning Environment, see Scardamalia & Bereiter, 1994) students engaged with the help of their teachers. I came to the field of CSCL after getting excited...
about the advanced processes of inquiry that these young students pursued. While the model has conceptual foundations, the actual elements and implementation of the models are based on insights that arose from an interaction between teacher-practitioners and researchers (see Hakkarainen, 2003b; 2004).

Progressive inquiry is a pedagogical model designed to facilitate expert-like working with knowledge in the context of computer-supported learning (Hakkarainen, 1998; Hakkarainen 2003b; Hakkarainen, Lonka & Lipponen, 2004; Hakkarainen, Palonen, Paavola & Lehtinen, 2004; Muukkonen, Lakkala & Hakkarainen, 2005; Muukkonen, Hakkarainen & Lakkala, 2005a, 2005b). In the background of the progressive-inquiry (PI) model, there is Carl Bereiter’s and Marlene Scardamalia’s knowledge-building approach that evolved from their pioneering research on writing, intentional learning and expertise (Scardamalia & Bereiter, 1994, Bereiter, 2002; Scardamalia, 2002). This approach emphasizes the learner’s active and collaborative direction of his/her own process, including setting objectives, the formulation of hypotheses, questions and subquestions, the revision of concepts and self-monitoring of the state of one’s knowledge, what one knows and still needs to find out. Their approach is valuable because it has both practical and theoretical depth; a knowledge-building approach is likely to bring about transformation in learning communities supporting higher-level processes of inquiry as well as fundamentally changing one’s way of understanding educational processes.

Another theoretical foundation of PI is philosopher Jaakko Hintikka’s interrogative model of inquiry that emphasizes the role of questions and question generation in knowledge-creating inquiry (see Hintikka, 1999; Hakkarainen, 1998; Hakkarainen & Sintonen, 2002). The PI model abstracts certain core processes involved in progressive inquiry and guides the implementation of corresponding pedagogical practices at various levels of education. The model has an empirical derivation as well; its developers consider the actual and best practices of scientists and other investigators. The model is being implemented, tested and developed in various schools and universities in Finland. Figure 1 provides an abstract description of the elements of progressive inquiry.

The PI model is designed to facilitate engagement in in-depth processes of inquiry and expert-like working with knowledge that are essential for productive participation in the knowledge society. Progressive inquiry entails that new knowledge is not simply assimilated, but constructed through solving problems of understanding. By imitating the practices of mature knowledge communities, the participants are guided to engage in extended processes of inquiry. Progressive inquiry is designed to be implemented in structures of CSCL activities. The users are guided to post their ideas and thoughts into a shared space and engage in many kinds of collaborative reflections and discussions. These postings are structured according to the elements of PI models. An essential aspect of PI is to engage collaboratively in improving the shared knowledge objects (hypotheses, theories, explanations or interpretations) that emerge during the process (cf. Scardamalia &
Bereiter, 2006). These knowledge objects do not need to be formally sophisticated, just ideas that the participants are concerned about.

M: Kai, could you explain what is the big deal about progressive inquiry? How do you see the significance of the model?

K: Together with my colleague Sami Paavola, I have been developing an approach that examines learning as a knowledge-creation process (see Paavola, Lipponen & Hakkarainen, 2004; Paavola & Hakkarainen, 2005), that is, the learners through their own collaborative efforts improving their knowledge and concepts, through a kind of internal dynamic; that is, not simply taking in, storing and assimilating knowledge or facts. I think that the PI model involves epistemic activities, such as the participants posing questions, generating their own working theories and engaging in deepening inquiry, all of which are essential in knowledge creation. These are all essential aspects of productive working with knowledge. Our development of the PI model was partly based on observations of scientific and inquiry practices. It is crucial for students to practice these kinds of activities from the very beginning of their education. It may sound very easy, but it is not. A kind of epistemological shift seems to be necessary in order to implement practices of progressive inquiry in education. It means that one needs to learn to see learning and knowledge advancement in terms of transforming questions and tentative theories proposed by the participants themselves, rather than as simply assimilating already existing
ideas and thoughts. Our approach to progressive inquiry has evolved in a direction that involves seeing epistemic actions as inherently embedded in social practices prevailing in a classroom. By relying on PI, motivated teachers have been able to create local classroom practices that channel the participating students' limited cognitive efforts in a way that facilitates collaborative knowledge advancement. Consequently, epistemic advancement and the transformation of social practices take place hand-in-hand.

4. Stages of Progressive Inquiry – Illustrations from the Life and Death Project

In the following, each aspect of progressive inquiry will be briefly discussed. We will use Marianne's Life and Death project as an example of implementing the model in practice in an elementary-level classroom. This, like all Marianne's other projects, is accessible on the Internet (http://www.kolumbus.fi/mabohu). At the time of conducting these dialogues, Marianne had worked 1st (7-year-olds) to sixth (12-year-olds) grade students, following the progressive inquiry method. The progressive inquiry specifies certain epistemologically essential elements that an inquiry community needs to go through (Figure 1) although the relative importance of these elements, their order and actual content may involve a great deal of variation from one PI project to another.

Creating Context

K: A starting point of the process of inquiry is to jointly create a context for the project in question. This aspect of the PI process is designed to ensure that inquiry does not focus on learning something just for school, but serves more substantial, intellectual aims. Through creating context the issues being investigated may be anchored in complex real-world problems that the students genuinely care about. It is essential that the students and teacher agree that the topic is worthy of investigation, and personally commit to work on it. In addition, it needs also to be sufficiently complex and multifaceted.

M: The progressive-inquiry project in my 6th grade class started when I talked with the teachers of the parallel classes about a loosely shared topic that we would like to work on jointly. Some articles about euthanasia had appeared in the Finnish press which attracted the interest of both myself and my students. The Life and Death project emerged from these discussions as well as from a necessity of delicately dealing with recent deaths in the students' families. In the beginning, we teachers discussed, on a general level, potential areas and issues covered by the Life and Death topic as well as key aspects of the curriculum that could be integrated with the project. The topic appeared to involve opportunities to work with several domains of knowledge, such as biology, history and religion.

K: What was your students' role is designing the Life and Death project?

M: It was crucial; the students and I discussed a lot of it together, and everyone got really excited. The direction of the project was almost completely determined by the stu-
ents through our joint discussions. Consequently, the Life and Death Project did not advance in such a linear way as introduced here; it meandered, went back and forth, came back to earlier questions and turning points (more like a hypertext rather than an ordinary text). It is linearly presented here only to make it more accessible to the readers.

Engaging in Question-Driven Inquiry

K: I think that there cannot be a genuine process of inquiry without questions. In my mind the idea of a PI model is to create a culture in which students are themselves encouraged to pose questions that will be jointly pursued. Sometimes it is perfectly all right for a teacher to pre-structure students’ activities by selecting questions herself. I would like to further highlight the cognitive value of questions that arise from the participants’ own need to understand and their wonderment process of inquiry.

M: I started to explore the principles of PI by gradually tasting. I decided to try a more child-centered method of working … I felt that I could start working in a very open way, at least in the beginning. Following the National Curriculum Guidelines produced the only constraint, but in Finland the curriculum provides a great deal of room for making modifications. I considered a focus on understanding to be important and searched deliberately for tools or aids to support it. Posing questions appeared to have an essential role in respect of PI. I tried to think of my own role in discussions and how much I could bring up my own thoughts. I decided to teach things only by following students’ questions. I wondered whether children would themselves find a core idea by asking questions, that they, as well as me as a teacher, would consider important. I also took note of whether they would propose deepening questions or be satisfied with a narrow answer.

K: How can the results of your explorations be seen in the implementation of the Life and Death Project?

M: The fields of inquiry concerning the Life and Death project arose directly from the students’ interests. Our [teachers’] preliminary ideas were not introduced to the students; instead, each student was given the task of writing down any questions that the topic of life and death brought into his or her mind. This task was anchored in some classroom discussions that had taken place before and created the context for the project. The preliminary teacher discussion helped us to prepare for the project in respect of foreseeing what kinds of topics might arise in discussion with the student. It also gave us the opportunity to relate the issues brought up by the students to the key contents of the curriculum. We [the teachers] went through the students’ questions together in order to categorize them, find out what broader fields they covered and to decide in what directions the projects could go in order to answer these questions. The questions that were loosely grouped by us were then moved into the network-based learning environment for all participants to see. We ended up having five principal questions that structured our project:
• What is life?
• How did life begin?
• How did life develop on the Earth?
• What is human life?
• What is death?

Generating Working Theories

K: An important aspect of progressive inquiry is the generation of the students’ own hypotheses, theories or interpretations of the phenomena being investigated. Construction of one’s own working theories guides the participants to systematically use their background knowledge and become aware of their background assumptions. I would say that working theories represent the use of a participant’s background knowledge to tentatively explain the things being investigated. PI is intended to create a culture for facilitating explication and externalization of these intuitive ideas through writing about one’s own thinking and reasoning and taking them as the object of collaborative discussion. How have you, a teacher, gone about facilitating the generation of working theories?

M: Well, we began with a discussion about life. The students were given the opportunity to tell their fellow students about things they remembered or knew about life as a phenomenon. In this way, we tried to anchor the issues being investigated to the students’ prior knowledge and conceptions. An important aim was to really help to bring the students’ voice to the front. One student was usually assigned to write down the issues raised in classroom discussion on a word-processor, and the document was saved into the school’s Intranet project folder which could be accessed by all students. During the discussion, each participant examined this document, and those aspects that were missing or inadequately represented were gradually added. This document, jointly created by the students, constituted the starting point of the project (http://www.kolumbus.fi/mabohu/elama/el.html).

K: How did your joint discussion of Life and Death advance?

M: In this initial discussion about life, many important issues about biology came up. These involved a great many important questions that the students wondered about, and these questions became the starting problems of the project. The first questions the students wanted to find answers for were the definition of life and different forms of life. It instantly became evident that, while the students remembered a great deal about this topic from earlier school years, a lot of new information was needed in order to begin to understand what life is. The students produced all kinds of explanations; sometimes we were all overwhelmed by the complexity of the topic.

K: It is very interesting the read your students’ productions. You know that reading the ingenious conceptions of very young students made me become interested in pursuing CSCL research in the first place. Over many years, I have constantly struggled to get
Finnish students to pursue their own explanations. Reading your students’ productions, Marianne, provides systematic evidence of epistemic agency, specifically, in that the students were committed to collaboratively pursue their inquiries. It appears that, like the findings of the Canadian students, the frame of your students’ explanations appears to be only concerned with human life, rather than a biological conception of life in general (Hakkarainen, 2003b). This can be seen in the following working theories concerning the preconditions of life:

A human being must sleep so that the body can rest. Humans and animals also need physical activity and healthy food to stay healthy and well. (Pauliina, pupil)

Nowadays it is important to live in a house whereas earlier people lived in caves. (Heidi, pupil)

Living requires water and food. (Nikolas, pupil)

Nowadays … nearly everybody has a mobile (cell phone), which seems to be more important than life for many people. Everybody also seems to require cars and things. (Ninni, pupil)

**Critical Evaluation**

K: After generating working theories, it is essential to assess the strengths and weaknesses of different explanations and approaches. It is, moreover, important that the students themselves learn to assess their advancement. In general, critical evaluation is needed to help the inquiry community direct and regulate joint cognitive efforts and evaluation of what knowledge and skills are needed in order to make progress.

M: Once in a while, I asked the students to stop all activities and gather around me to assess the advancement of our project. We projected collectively developed ideas on a wall with the help of a video projector and reflected on them. We engaged in a deep discussion concerning whether we had succeeded in answering our questions and how we had progressed. One of the students made notes on the shared screen on the basis of our classroom discussion during our joint discussion.

K: This appears to be a very advanced practice that also has theoretical significance. Without being aware of the theoretical notion of “rise above” (Scardamalia, 2002) processes, you have invented, in practice, cultural activities that serve this purpose, i.e., encouraged your inquiry community to rise above its earlier understanding and find productive lines of inquiry. But I want to ask you, did you encounter any problems with students trying to assess their own understandings? Did they have great difficulties? How well did they succeed?

M: I think that the students were relatively clearly able to assess the depth of their understanding. They often stated openly that their knowledge of the issues being investigated was not sufficient, that it was at too general and unspecific a level. This awareness was noticed when we jointly wondered how our inquiry was going and what we had [thus
far] written down. We tried to find an answer or answers to certain specific issues concerning the problems being investigated that appeared to be difficult to explain. The students identified issues that appeared to be necessary to understand in order to progress. Sometimes it was rather difficult to formulate subordinate questions so that they would reveal what we really wanted to know. The students pointed out that they would «need to understand the phenomenon at an even deeper level» (quoting their own expression) and to have detailed knowledge concerning how things had happened. We went through these kinds of contemplations together. After getting into a corner of critical knowledge that was likely to involve more specific explanations about the phenomenon and finding knowledge associated with it from information sources, they understood that they had advanced and become more deeply involved in investigating the issue in questions. While dealing with a complex issue, it was still necessary to go through it together and examine what it was all about.

Searching for New Information

K: The question-driven process of inquiry provides heuristic guidance in the search for new information. Without obtaining new information, for instance by using literary sources, consulting experts or conducting one’s own explorations, the process does not lead to genuine advancement. How were these aspects of PI accomplished in your project?

M: The students were set to explore diverse sources of information in order to find answers to their questions. The information found was also saved in the Intranet project folder so that all students could view the information others had found. It helped that the questions were common for the whole class, and thus everyone tried to find information about these same topics. The decision to do it this way was intentional: I wanted to avoid the task being split into small individual subtasks and to foster the sharing of knowledge and collaboration in the process of building new knowledge. In this way, all the students had some knowledge of the issues by the time of the next discussion and could thus contribute to the conversation. While the students were allowed to use the information found by other students (and documented either in the common Intranet folders or in the network-based learning environment) and build on that, each student was obliged to process some text of their own. Individual cognitive responsibility was regarded as important, and thus each student’s minimal participation in the knowledge-building process had to be ensured. It soon became apparent that the actual preconditions of life differed from the students’ initial hunches:

... But the actual preconditions of life are oxygen, water, energy and green plants, which produce oxygen for us. (Ninni, pupil)

Life is possible because the earth is surrounded by an aerosphere [atmosphere] through which the harmful radiation of the sun cannot enter, but this aerosphere does not protect
against UV-rays and we can protect ourselves from it through clothing and sunscreen. (Petra, Emma and Terhi, pupils)

Necessary for life is an atmosphere that protects the earth from the dangerous radiation of the sun. Also death and the right distance from the sun is necessary so that it would not be too hot or too cold, but approximately between minus ten and plus thirty degrees centigrade. (Kim and Make, pupils)

K: These appear to be more sophisticated accounts of Life and Death, such as the following explanation of the beginning of life. I would have had difficulty in understanding all these biochemical processes. The mere translation of your students’ scientific information took a long time and forced me to consult my dictionary repeatedly.

According to one theory all life began from methane, hydrogen, nitrogen, carbon dioxide, water vapor and other gases, which then created amino acids and sugar. Life then developed from proteins, which consisted of sulphur, oxygen, nitrogen, hydrogen and carbon. However, this wasn’t enough for life to begin. What was also needed was liquid from water (a temperature between 0 and 100 degrees centigrade), the planet must be big enough so that its gravitation manages to maintain an atmosphere around it, there must be an ozone layer that protects from the sun’s UV radiation. For life to develop, time is also needed. The transition of life from water to ground lasted about 4 billion years. (Sirja, Päivi, Sirkku, and Pauliina, pupils)

M: I made a great effort to find “scientific” explanations that would be at the level of children’s understanding of conceptual issues that appeared to be difficult to understand. I have noticed that a school text book is never sufficient as an information source, even when you are studying an apparently ‘simple’ problem. I believe that each progressive-inquiry project is also a PI project for the teacher because she needs to go through a much larger space of possible knowledge in order to be able to guide students’ advancement.

K: It is critically important to guide the participants to use authoritative sources transformatively, instead of copying them (Scardamalia, 2002). I have seen many times, even in the most advanced schools, that students just copy information to the computer environment. How did you try to solve this problem?

M: My students are not allowed to take books with them to the computers; they are guided to write short notes instead.

Generating Subordinate Questions

K: It is essential to understand that in authentic problem-solving situations you have to start generating questions and tentative theories before you have all information in hand. Therefore, inquiry often starts with initially very general and ‘fuzzy’ questions and tentative working theories (see Hakkarainen & Sintonen, 2002). A critical condition for progress is that the participants focus on improving their ideas by generating more specific questions and searching for new information. The dynamic nature of inquiry arises
from the fact that the generation of intuitive explanations and obtaining new scientific information make new research questions accessible to the students that they could not have foreseen at the beginning of inquiry. By finding answers to subordinate questions, an inquirer approaches – step by step – the original ‘big’ question. Inquiry is advanced by this process of transforming initial unspecific questions into more specific ones and pursuing these questions in depth.

M: In the context of the Life and Death project, the students derived several series of new questions from the principal ones. There were several lines of inquiry. After the students had gathered some knowledge about the issue, the information they had found (documented either in the common Intranet folders or in the network-based learning environment) was viewed together. The video projector was used for collaboratively viewing and discussing the documents created by the students. As the texts of all the students were discussed, the students noticed discrepancies and contradictions between the information from the different sources they had used. This led to more specific questions or problems, and the students thus tried to find out which items of information were correct. As this proved difficult (the different sources of information indeed included controversial information), a decision was made to search for answers by asking an expert, in this case, an upper secondary school biology teacher. Through classroom discussion, groups of students were guided to share their knowledge and integrate divergent lines of inquiry. Some of Marianne’s students, in fact, engaged in very deep inquiry (http://www.kolumbus.fi/mabohu/elama/synty.html).

M: Some students went on their own to search for knowledge from libraries about issues that interested them – and spontaneously used PI in their knowledge acquisition without being aware of it. I noticed that when students found information they started to wonder about new things. They deliberately searched for answers to something that they wanted to find out. I remember a particularly specific and interesting analysis of bath culture in Ancient Rome and matrimonial ceremonies. These topics, in particular, attracted the other students’ interest because these were not mentioned at all in school books.

Constructing New Working Theories

K: After going though a cycle of inquiry, the participants of PI are encouraged to generate new tentative theories and explanations for synthesizing their conceptions and summarizing their individual and collective learning and knowledge-building.

M: While working with theories of Life and Death, the students’ inquiries touched the edges of our joint knowledge. The class expanded its inquiries into several domains of knowledge. The students investigated questions of life and, in particular, death in various cultures and in different times (history) as well as in a number of religions (http://www.kolumbus.fi/mabohu/elama/kultuurit.html). These parts of the project were realized in a similar manner as the biological part. The students also visited an exhibition
about Ancient Egypt at the Heureka Science Centre, and had a Lutheran minister visit them to answer their questions about conceptions of death in the Christian religion (in Finland there are not, however, such strong tensions between religion and science as in the US). In addition, they created a play. Further, studies on the Finnish language, music and the visual arts were included in the project by writing about different topics and including drawings. After examining how life and death were dealt with in Ancient Egypt (House of Life and Death, http://www.kolumbus.fi/mabohu/elama/kuolema.html), Marianne guided her students to build Houses of Emotions to visualize and concretize their theories of Life and Death (http://www.kolumbus.fi/mabohu/elama/talot/talot.html). These expansions were needed because life and death are not just biological processes, but involve cultural and human aspects that have to be taken into consideration (see Marianne’s students’ visualizations concerning life http://www.kolumbus.fi/mabohu/elama/elamansirpaleet.html).

K: How did you organize your activities at this point of the process?

M: After the students were satisfied with the information they had found to answer the set questions, the texts written by the students were viewed collaboratively with the help of the video projector and the network-based learning environment in order to develop these texts into well-formed answers to the research questions posed so far. The discussions that took place in the network-based learning environment were used as material for this. Students summarized these discussions and the summaries were again viewed collaboratively in order to find out whether all essential aspects had been included. The final report for each question was constructed using Netscape composer for creating web pages, which were then included in the network-based learning environment. The aim was not to produce as much text as possible, but rather to reduce the text size in order to have manageable and compact answers to the initial questions, from which the process could then be continued.

K: It appears to me that your students really engaged in deepening inquiry. This is a rather demanding pedagogical achievement. How did you do that?

M: The students really came up with new questions that led the project forward. As the students reported their final answers to the question about what life is, they started wondering how life had started on earth. This was, then, the next step of the process. In the continuation of this process, more and more questions arose concerning the topic of how life developed on earth. Since the process of evolution is very long, this issue was divided up according to its different phases, and the class was divided into groups so that each took responsibility for creating a description of one such period. The students were then asked to comment on other groups’ reports in the network-based learning environment. Again, the work did not stop when these descriptions were ready, but they were used as material for further inquiry. Reading through each others’ reports of the periods of evolution, the students became puzzled with the question, about the order in which
various animals had originated. Since the reports written about the various phases did not answer this question, the inquiry continued until satisfying answers had been found. Due to the complexity of the topic, the students had to acknowledge that they were not able to answer their questions.

K: I think that students who pursued the question, 'What Is the Meaning of Life' nicely pointed this out:

*There has been no answer to the meaning of life yet. So the meaning of life is not known yet, but everybody certainly has his or her own theory about it. It can, for example, be just that it is wonderful that there is life, reproduction and fun. Nobody knows the meaning of life properly; everybody can think it for himself or herself. But I think that we should make the best out of life while we still can.* (Matu, Tiina and Heidi, pupils).

**Shared Expertise**

K: All aspects of inquiry, such as setting up research questions, searching for new scientific information, constructing of one's own working theories or assessing the explanations generated, can be shared with other inquirers. Progressive inquiry is often very difficult. Advancement of inquiry can be elicited by relying on socially distributed cognitive resources emerging through social interaction between the learners, and collaborative efforts to advance shared understanding. Groups that consist of members who have heterogeneous, but partially overlapping, expertise are often more effective and innovative than groups with homogeneous expertise.

M: According to my experience, one difficulty involved in project learning was the organization of cooperation between students working in groups. A group's task is often split into non-overlapping, individual tasks, whose results, in the end, students try to «glue» together into the group's results. The method does not satisfactorily solve the problem of weaving these separate lines of inquiry together: the students are not usually motivated any more, at the end of the project, to integrate the diverse research results.

K: I agree. It is a typical problem in more traditional forms of cooperative learning that the distribution of roles and sub-tasks actually becomes the focus of the learning activity instead of solving the cognitive problems that are the main object of activity (cf. Hofmann, 2006; 2008). How did you organize collaboration between your students, Marianne, over the years of exploring with PI?

M: If you want to have your students discuss and negotiate about the issues that they had studied themselves, you have to start practicing from the very beginning. My students formed a very talkative group. I soon realized that more difficult than keeping students silent was teaching them to talk in a controlled and disciplined way. Still, it was essential to provide an opportunity for students to discuss things in the classroom. Consequently, students were encouraged to sit close to each other. This habit remained our way of organizing the physical space throughout the six years I worked with them. The
formation of functional teams as I gradually changed the students’ places was an activity that took place once in a while. Here I aimed at the largest possible change in the composition of the groups. The students knew each other’s good and bad habits and knew exactly when working together would succeed and when it would not. I had also my own rules; in each group there had to be both girls and boys, always. We started to systematically practice alternate listening and speaking while working with tasks. We used several models so that students one by one took the chair’s position, read tasks and gave opportunities to speak, to all the participants. Later on, these become routines. We experimented with how loudly you can work so that the noise would not be disturbed. We talked about when it is useful to borrow a model of or imitate another pupil. We discussed how you could provide advice to your fellow students without immediately giving the answer. The students explained what it feels like when you discover something yourself. Later on, we continued various exercises and gave roles and tasks to members of teams. We learned to make notes of discussions by hand or by using a computer. We went through various forms of discussion. We discovered a novel way of using the video projector for sharing material with the whole class, while giving a presentation.

K: The progressive inquiry model is a tool that helps teachers or tutors to engage their students in expert-like working with knowledge. Teachers and tutors have an important role in guiding and facilitating progressive inquiry. They should guide students themselves to take on responsibility for all aspects of inquiry, such as goal-setting, questioning, explaining and evaluating, and guide their process of inquiry by their own example. Investigations of my research group indicate that students cannot easily break the constraints of current pedagogical practices without the teacher’s cognitive guidance. So the teacher is really the heart of the process. How do you, Marianne, see the teacher’s role in progressive inquiry.

M: Although the project presented here may appear easy to organize, it is the end result of many years’ intensive effort. My own path of learning progressive inquiry has been a very long and demanding one, constantly requiring my own progressive inquiry process that is still continuing. New CSCL teachers should not expect everything to go smoothly or work well to begin with; both you and your students need to learn a novel way of working. Talking about the teacher’s role … I have found a young Finnish philosopher, Pekka Himanen, very helpful. He has written a book called ‘Hatchery’ in which the various roles of a teacher are examined, following Socrates’ example. According to his interpretation, the teacher may be seen as a gadfly that kicks and stimulates, assesses, proposes and interferes. This is not, however, enough. The teacher also needs to be a midwife who creates a classroom situation that helps students to get their thoughts going and visible. She has to guide their writing and communicating, encouraging them to question, search for new information, and create knowledge. It is essential that she should be open to new ideas, bring in thinking tools and new ideas, provide students with support and require their
efforts. Finally the teacher has to be an organizer of the whole group, providing for everyone according to their needs and taking care that nobody is ruining the atmosphere.

Discussion
The Life and Death project illustrates very clearly the advantages that collaborative technology can have for collaborative learning. The experiences of this project indicate that the network-based learning environment should not necessarily be considered as the primary space for sharing knowledge and collaborative knowledge-building. Rather, as suggested in the present PI project, the network-based environment may function as a space for gathering knowledge and documenting the process of knowledge-building, while a great deal of the actual sharing of knowledge takes place in the face-to-face rise-above discussion in the classroom, i.e., in the physical space. Nevertheless, as this example shows, the technological tools are an irreplaceable and vital part of this space, without which such collaboration and knowledge-sharing could not occur. The discussion forum of the network-based learning environment, as well as the school’s Intranet (combined with a video projector), allowed the teacher and the students to make the students’ ideas visible, throughout the process; hence the students could profit from the information gathered and ideas developed by others, since these could be discussed together.

K: When I think about my old argument with you concerning project learning afterwards; I feel that my assessments were too categorical. I contrasted project learning with knowledge-building inquiry, having as a rhetorical intent, to promote the latter. As often happens in these kinds of situations, I did not sufficiently highlight the variability within the project-learning approach. Many aspects of progressive inquiry actually become quite close to sophisticated varieties of project learning. I am certain that an enthusiastic and committed teacher is able in practice to break the boundaries of pedagogical models: pedagogical categories are, after all, abstractions rather than representations of reality as it is. I was not able, however, to convey these thoughts to my audiences, and perhaps unintentionally offended many of the most committed teachers who had been doing great work within the project learning approach.

M: As a consequence of the intensive work that I have done with my students, I now know much more about PI. The fact that I have been in direct contact with research communities and obtained information from the newest investigations has considerably influenced my work. I was glad when I noticed that researchers have started to pay attention to experiences and conditions in the field. You researchers have started to understand those constraints that often prevent fast changes or instructional transformations at school. Your studies are apparently aimed at supporting teachers, not labeling them incompetent or unnecessarily pointing out mistakes. Some of your students have made academic study reports of my projects. From these reports I have observed the things I have succeeded in and others where my pedagogy needs improvement. I believe that I am
able to take criticism without getting mad. The things that you have addressed have helped me to understand how my PI appears to you, how open it has been and how my students have experienced my teaching. I will now ask you things that I have been wondering about and that I suppose other teachers are also pondering when they apply the methods of PI in practice. Simultaneously, I will tell about my own learning path and hope that I will find a couple of missing pieces to my jigsaw puzzle...

K: My view is that good CSCL practices have emerged through interaction between teachers and researchers. Innovative teachers have explored computer-mediated practices of working with knowledge in their classrooms. Often their work has been inspired by researchers’ approaches and pedagogical ideas. In many cases, however, teachers are able in practice to go beyond the ideas that were the source of original inspiration and invent new pedagogical practices. It appears as if classrooms of such teachers are spontaneously formed expansive-learning communities (Engeström, 1987) in which novel practices emerge through iterative efforts that involve reflecting on weaknesses of prevailing practices, implementing and evaluating changes and using the emerging best practices as a starting point of subsequent iterative efforts (Hakkarainen, 2003a; 2003b; 2004). Researchers, in turn, may conceptualize this emergent phenomenon so that there is continuous co-evolution between pedagogical practitioners – teachers – and researchers. I believe that these kinds of processes are apparent in Marianne’s insightful rise-above sessions that have a potential to inspire other teachers and their practices. It appears essential to facilitate closer interaction between teachers and researchers by creating a hybrid culture in which both of these domains of expertise are cultivated and their growth alongside one another encouraged. This is the reason why I have decided to work for a closer integration between our efforts, so that we would be continuously available to provide advice when you are planning and actually conducting your PI project, rather than you having to read our reports afterwards; and, in turn, you would come here to us, from time to time, and report on the results of innovative CSCL experiments to the international scientific community. Such collaborative processes may enable us to jointly go beyond boundaries of the initial progressive-inquiry approach and take it as an expansive object of an emerging, practice-driven co-configuration.

In the present article, the relations between pedagogies concerning project learning and progressive inquiry were examined through a dialogic interface in an interaction between a teacher-practitioner and a researcher. Although the dialogues addressed the relative merits of the two pedagogical methods mentioned above, the argument of this article is not to claim superiority of the latter one. Clearly, it is not abstract theoretical models as such that determine the pedagogical value of educational innovations; the crucial issue highlighted by the present examination is to utilize pedagogical models, such as progressive inquiry, as resources that guide the transformation of classroom practices in interaction between teachers and researchers. While experienced teachers are able to engage their students in progressive inquiry processes, it is never a matter of linear progress or straight-
forward application of a body of pre-set guidelines. In order to explicate the tension-laden implementation of progressive inquiry in practice, the present investigation has brought various aspects of teacher-researcher interaction to the foreground.

References


