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KP-LAB

Knowledge Practices Laboratory

Integrated Project

Information Society Technologies

D9.2 A Collective Case Library about pedagogical models and related practices, v. 2

Appendix: Case descriptions organized according to the Priority Areas

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PA 1: Managing collaborative design in teacher education

ELTE – Visualization in Art and Science Education

The site at which the case is conducted: Eötvös Loránd University, Faculty of Science, and Moholy-Nagy University of Industrial Arts, Budapest, Hungary

Short case description

This case examines the role of visualization in developing epistemic agency and achieve boundary crossing between the world of work (software design) and education (primary and secondary level art and science instruction). The case explores the visualization potentials of the MOVELEX VLE software and other digital tools of visualization of concepts and processes. We invite pre-service and in-service secondary school teachers of Art and Science to develop epistemic agency and assume responsibility for the advancement of their knowledge and inquiry through authoring knowledge objects. Teachers reflect on the role of visualization in teaching and learning processes in arts and science (during independent in- and pre-service university courses for art and science teachers), collaborate with trainers and software developers to create authentic learning tools, introduce them in teaching and evaluate results of learners as well as their own development through the process.

The pilot, two semester Educational Technology courses (September 2006 – May 2007), targeted in-service art and science teachers and fourth year design students who have just started their training as educators. Both learner groups included teacher trainers and software developers working in boundary crossing professional teams. Based on pilot experiences, software applications, course content and methodology will be improved and teaching repeated each semester between 2006 and 2008. The experimental courses for both groups that will include longitudinal follow-up of student development and the use of KP-Lab tools Mapit and Shared Space and social software (ePortfolio and blogging environments), involve knowledge construction processes assisted and also documented through the use of visualization tools.

Research questions

1. What is the role of different visualization techniques in developing epistemic agency in arts and science education for novice and expert teachers?
2. What is the role of different visualization techniques in understanding, acquisition and retention of art and science concepts?
3. Which methods of co-evolution (triological development) of educational tools for visualization are efficient in two distinct knowledge construction areas: art education and in teaching science?

Research approach and methodology

In the pilot course, pre- and in-service teachers experimented with the teaching of a variety of art and science concepts and processes through text-based and visual resources and assess their respective effects on learners. New methods of visualization were developed through co-evolutionary processes of software developers, pre- and in-service teachers and their trainers. Jointly developed resources were tested in school environment. Pre-service teachers constructed e-Portfolios about tool development experiences and school based trials. In-service teachers reflected on toll development and testing through questionnaires and

structured interviews. Visualization tools developed by all professional groups (Art and Science, pre- and in-service) were collected to document content, methodology and effects of visualization tools in these two distinct learning areas.

During future courses, Mapit and Shared Space will be utilized to visualize planning and evaluation work of stakeholders in the training process. Other sources for analyses involve: tests and oral examinations, e-portfolio, synchronous and asynchronous online forum discussions, interviews and video-taping of micro teaching.

Data analysis and conclusions

1. Role of different visualization techniques in developing epistemic agency in arts and science education for novice and expert teachers

Both pre-and in-service teachers in Art and Science succeeded in forming communities of practice to co-operate with teacher trainers and software programmers and created new / improved existing functionalities for the Movelex VLE although different levels and forms of boundary crossing were observed in disciplines and also at different levels of teaching expertise. Experienced Science teachers were most open to co-evolutionary practices while pre-service Art educators restrained to color and form design suggestions and had to be introduced to collaborative knowledge construction. Software developers served as catalysts between teacher trainers and learners providing practical answers to methodological issues demonstrated during the teacher training process. Widening the array of pedagogical options for their discipline resulted in developing epistemic agency for novices and reconstructing existing epistemic agency for experienced teachers. Movelex proved to be a useful visualization tool and a Web-based digital learning content development platform at the same time

2. Role of different visualization techniques in understanding, acquisition and retention of art and science concepts

In the pre-pilot phase, two product oriented (presentation, animation) and one process-oriented (e-Portfolio) visualization technique was employed. Presentation and animation was employed in school based teaching assignments by pre- and in-service teachers and also in the course of their training. Results of the school based trials were measured for knowledge comprehension and retention. For comprehension, animation with accompanying text was more useful than presentation, for retention, however, presentation including still images and text on the same slide was more effective.

3. Efficient methods of co-evolution (dialogical development) of educational tools for visualization in art and science education

E-Portfolio proved to be an excellent means of collecting, organizing and sharing collaboratively constructed knowledge. Further design oriented research will be conducted in future courses with more sophisticated e-Portfolio software including social software components (PET-Portfolio of the University of Newcastle). For monitoring discussions, note taking by non-participant observers and follow-up interviews and blogging by learners was employed – and found insufficient to document intricacies of pedagogical debate. In future courses, Mapit will be used for discourse analysis and also as a visualization tool of building / reconstructing epistemic agency.

UniNE: Argumentation in Science Education

Short case description

The whole pedagogical design of the course¹ (called “argumentation and learning”, given in the University context with students who are future teachers or having teaching experiences yet) is meant as allowing students to be initiated to the design of argumentation activities in teaching science, and to analyse their potential benefits. In this scenario participants are invited to learn by doing. It is designed in order to articulate times where students are exposed to concepts and methodological tools on argumentation in a “monological” way (ex cathedra lessons), times where they resolve problems, plan activities, work on texts, etc. in collaborative groups (in a “dialogical” way), and times where they are invited to collaborate in and for transforming practices and knowledge (knowledge creation) also with the help of ICT tools, like Digalo. Through this design, students experiment different social and professional positions, the ones of learner, teacher, and researcher.

Five main interrelated steps structure the scenario:

- Theoretical and methodological contributions
- Collective work on elaboration of a « good argumentative scenario in sciences » (in small groups)
- The test of a first version of the scenario (among the students, in small groups)
- The test of the scenario with pupils in classroom²
- The writing down of the main results of data analysis and reflexive position about their work.

Research approach and methodology

From the analysis of the data collected, our main research objectives are to observe how learning to teach argumentation «by doing (collectively)» leads participants to develop new understanding of teaching practices and knowledge on psychosocial issues of argumentation, but also to (start to) build a new professional image of themselves and of science.

We thus expect to better understand how the students’ understanding of argumentation issues is elaborated in and through such a pedagogical design. We are also interested in how their teacher’s role understanding develops (in which extend).

In order to better understand what kind of knowledge they produced in which kinds of practices, we gathered data, mainly:

- Pre- and post-questionnaires (about their representation and knowledge on argumentation, argumentation and learning, teacher’s role, ICT use in pedagogical settings, etc.³)
- “Observation-participation” (the researcher is the teacher; written notes)
- Research diaries of the students
- Written reports by the students.

Data analysis and conclusions

From the first analysis of the data collected, it seems that in learning to teach argumentation

¹ Two scenarios have been tested at University of Neuchâtel by N. Muller Mirza around this topic, with some changes: the first one (2006) was more focused on how to develop an argumentative design in science with reflections about scientific reasoning and science development, and the other one (2007) on how to implement an argumentative design in a classroom. Both had been conducted during one semester with about 25 students in 2nd and 3rd year in psychology and education.

² Only for the second scenario.

³ Pre and post questionnaires have been filled up only by the second group (19 people) in 2007.

“by doing (collectively)”, the participants not only do develop new knowledge on psychosocial issues of argumentation, and of teaching practices, but also they do (start to) build a new image of themselves and of science.

In particular, the results show that the students develop :

- knowledge on teaching practices. Students developed knowledge on how to teach, mostly related to four “objects”:
 - o the “pupils” (how to motivate the learners)
 - o the content (how to present and explain the main scientific notions that are at stake...)
 - o the argumentation itself (how to prepare the students for the debate phase, what kind of resources to give them, how to formulate good controversial questions for the debate...)
 - o themselves as “experts” (what to know in order to be a good teacher in argumentation for a specific topic);
- knowledge on argumentation and its role in learning. The analysis shows also that students develop new understanding about the psychosocial issues of argumentation in education (around 58% of the students say that they learned “a lot” about this topic and 42 “a bit”; the written reports show a good quality in the quoted theoretical references; we did not have enough time however for working on methodological tools and issues of argumentation analysis);
- knowledge on how science evolves. From a quite classical representation of science developing through successive discoveries, students become more aware that sciences evolves in discursive processes where the scientific not only “converses” with reality through hypothesis and verification processes but also and mostly with his/her colleagues.

It is interesting to observe that these three dimensions of knowledge (knowledge on teaching, on argumentation and on science) are indeed interconnected: it is as if an understanding of the science as embedded in argumentative practices had impact on the way students elaborate a pedagogical scenario in science. A group of students, for example, write: “[we advise the teacher to invite the learners to discuss their perspectives and reach a consensus...] as it is less in the response in itself than in the process, this quest of a truth, that is important and that is the guaranty that cognitive skills and critical thinking are developing by the pupils”.

In the questionnaires, students say that they mostly learned new knowledge through the elaboration and implementation of the scenario in classroom (thus through concrete practices), and thank to the collaborative work with their colleagues. The reflexive position that was asked during the course (through taking notes in a diary) seems also a source of an effective learning, from the point of view of the participants.

UU: Innovative Knowledge Communities at Secondary School (UniC):

Short case description

Research that is conducted at UniC, an innovative secondary school in the Netherlands, is concerned with the investigation of developments in teachers’ pedagogical practices as a result of their engagement and participation in a multi-disciplinary team of researchers, teachers, students, school leader, and external experts who collaborate on the co-evolutionary design of a learning module that is based on principles of the knowledge creation metaphor.

The main goal this knowledge community attempts to achieve is to develop and to advance a course module in which students, in collaboration with others (i.e., students, teachers,

professionals, and/ or customers) create their own knowledge and develop agency during technology-supported authentic projects in which they work in small groups on shared objects. To accomplish this aim, the multi-disciplinary team at UniC is intensively engaged in crossing boundaries practices between the traditional roles represented by the various groups.

Purpose of meetings of the project partners served to improve the design of the learning module based on experiences of teachers and researchers encountered during implementation of the module and based on theoretical insights from the triological perspective on learning. This co-evolutionary process will take place longitudinally, spanning several modules.

Implementation of this module implies that a high demand is placed on the pedagogical practices of the teachers involved, since they have to: a) comprehend the theoretical principles behind the knowledge creation metaphor, b) apply these principles in their practice, and c) transform and reconsider their role as the more knowledgeable tutor to one in which they become one of the participants in their students' knowledge communities. The micro context of the project group and teachers' pedagogical practices is understood from the organizational and ethnographic context of UniC.

UniC is a secondary school in Utrecht where students can discover and develop their talents. UniC values differences between individuals and prioritizes students' own learning needs. In their pedagogical approach UniC coaches towards the national school exam, thereby not only focusing on knowledge acquisition but also stressing developing competencies, skills and personal development. Students work on themes or assignments in their own pace, at their own level, and can choose their own learning methods and tools. In this way, topics studied can associate to the world of the students, and motivate them to reflect and to discuss.

Teachers' practices at UniC normally involves developing themes and assignments and providing guidance for students' self-directed learning process. In addition, teachers give workshops in case students require more necessary or background information concerning particular knowledge domains. There are no fixed testing periods, which means that students can deliberate together with their teacher when they have accomplished an assignment and when they can take a test to complete the assignment. The nature and the timing of the end result of any assignment is negotiated with the teacher.

Furthermore, the teacher community at UniC can be characterized as highly reflective, since teachers observe each others' pedagogical practices and provide intensive constructive feedback based on their enquiries. Additionally, development towards self-reflective professionalism is strongly fostered at UniC, since a great deal of opportunities are offered for participating in in-service teacher courses.

Research questions

1. How can teachers' participation within the innovative knowledge community be characterized?
2. How did teachers' pedagogical practices develop during the project?
3. How did participation in the innovative knowledge community relate to transformations in teachers' pedagogical practices?

Research approach and methodology

The UniC case involves examination of knowledge practices on two interacting levels: a) that of the students engaged in learning activities, and b) that of the innovative knowledge community consisting of project partners who collaborate on the (advancement of the) design of the module which is based on principles of triological learning. The first level concerns

students' knowledge creation by collaborating around shared objects within an authentic context. Learning does not merely involve individual knowledge acquisition of social interaction between students, but moreover concerns shared transformations of ideas and social knowledge practices. This means that students, based on their prior knowledge and skills, create new knowledge and skills by collaborative working around shared artifacts using different tools and supported by their teachers.

The second level mainly concerns the participation of teachers within the innovative knowledge community which is engaged in a co-evolutionary design process focused on the collaborative creation of a learning module based on principles of dialogical learning. The data are based on articulations, reactions, and reflections and lead to knowledge advancement for construction of new practices. In short, this level in general involves a reflection on the knowledge practices occurring at the first level.

The research will focus on the innovative knowledge community in which participants collaboratively create knowledge. Within this context, participants will be also engaged in the explication of and collaborative reflection on their tacit knowledge regarding their own practices. The main objectives of the present research project can be summarised as:

- To assess and characterize knowledge practices and participation within this innovative knowledge community (IKC);
- To investigate how critical events within the IKC can be related to teachers' adapting their pedagogical practices;
- To develop suggestions for support of collaboration within the IKC and for the translation of issues raised to concrete measures on the level of teachers' pedagogical practices

In our research, we attempt to examine whether a linkage can be made between critical events identified during the meetings of the project partners and teachers' adaptation of their pedagogical practices during the project. Critical events are conceptualized as reflections of the participants on practices, feedback provided by other participants, and cognitive conflicts articulated during the meeting. Critical events are interpreted from recordings of the meetings and are checked within the team.

To assess teachers' pedagogical practices we combine the data collected from different instruments (i.e., multi-method triangulation), namely: knowledge objects (i.e., reports, concept maps, and comments), pre-and post questionnaires and interviews, and observations from recordings. The analyses of the pedagogical practices will focus primarily on teachers': a) support provided regarding the subject matter, b) scaffolding of the collaboration within student groups, and c) use of collaborative computer-supported tool (i.e., FLE3).

Data analysis and conclusions

1. How can teachers' participation within the innovative knowledge community be characterized?

Analyses of meetings of the project group are still being performed in addition to the iterative development of an analytic framework to characterize teachers' participation within the IKC. Preliminary analyses show that teachers have difficulty with their less directive role as a process facilitator and tend to fall back to their traditional 'deliverer-of-knowledge' mode. However, during meetings teachers expressed the need to change their practices to be more in line with the new pedagogical model. In addition, the role of researchers' participation during the project changed as a result of teachers' articulated that they required more directive feedback on their practices.

2. How did teachers' pedagogical practices develop during the project?

3. *How did participation in the innovative knowledge community relate to transformations in teachers' pedagogical practices?*

Although analyses of recordings of teachers' discussions with student groups are still being performed, the teachers' activities showed some patterns:

- Teachers were not able to precisely and consistently monitor what the students do. In part this is because it is not within their possibilities, because there were not enough teachers available to do this. But also, it was not common practice to interfere into students' content-related activities. However, they closely looked at individuals, especially the problematic students (on cognitive or behavioural level), in order to check if they were doing their work and are feeling comfortable with the group and its functioning.
- At first, teachers did not monitor group progress at the content level. With respect to dialogical learning, the teachers did not support reflection on knowledge objects. As a consequence, the students do not value the place of objects within their project work very much. After several meetings between researchers and teachers the importance of defining the objects and its criteria for completion with the students was discussed and agreed upon. Accordingly, teachers adapted this strategy by performing the same activity with their students, arguing that students' knowledge object is the motive and the focus of attention for their work. This was primarily done by focusing on students making general statements explicit and concise, and by focusing and agreeing on commitment instead of gratuitous verbal production.
- The teachers did at first not monitor the activities of the students closely enough, and might even did not seem to know what they were exactly to monitor. It seemed that, in this context, teachers have a role in representing either the stakeholder of the assignment or a participant/ facilitator in the knowledge work of the group. In addition, teachers came to acknowledge that they should explicitly address and evaluate student responsibilities in meeting the requirements of the assignment.
- Teachers acknowledge the importance on monitoring individual and collective student's reasoning and understanding. Still, it seemed that the teachers, although they have a different role, placed themselves outside the collaboration processes, because they hold the epistemic stance that their role should be facilitating the process at a distance instead of being part of the knowledge creation process. In some cases this led to the problem of students getting stuck and missing most opportunities for knowledge construction.

Teachers themselves did not make use of the electronic learning environment. They had the possibility to use FLE3 for keeping track of students' work development, but they preferred to ask the group about the progress made.

PA 2: Retooling boundary crossing between education and work

HUJI: Cross-boundary contexts and practices in EFL

Case Description

In a college context, pre-service teachers of EFL acquire knowledge in subject matter, pedagogy and technology, which they immediately apply in a semi-formal virtual exchange with high school pupils. In small groups where inter-personal connections were established, the students taught the pupils what they learned, and learned through their teaching, then each small-group worked collaboratively to develop a presentation on a topic relevant to all group members. In this case, close collaboration was envisaged between the college and school frameworks, and between the knowledge practices of the course instructors in relation to the knowledge domains they represented. Boundary-crossing processes, especially in terms of

how these are reflected in connections between different forms of knowledge (theoretical, practice-bound, tacit), and pedagogical metaphor underlying the various participants' practices were analyzed.

Research focus

The pre-service teacher's experience has generally been characterized by a theory-practice "divide" impeding the translation of theoretical concepts learned in the academic situation to actual practice, and the interpretation of classroom events in terms of theory. HUJI's case was designed to establish an appropriate setting for pre- and in-service teachers (the course students on one hand, and course instructors and school English teacher on the other) to make theory-practice connections as well as connections between knowledge in different domains constituting their study program. The case was designed to enable an understanding of learning and teaching in terms of boundary-crossing processes and learning-teaching metaphors that go beyond credos of mere acquisition.

The main objectives of this case were:

- To characterize the cross-boundary network at the organizational level: cross-institutional and cross-discipline;
- To characterize the cross-fertilization occurring between these two types of zones (institutional and cross-institutional; discipline/domain-based and inter-disciplinary);
- To determine the pedagogical metaphor underlying the teaching and learning of: the teacher trainers (course instructors), the school English teacher, and the pre-service teachers (the students).

The course is iteratively developed and improved based on insights gained from experiences of previous implementations of this course.

It was initially planned to implement the following methods for gathering information relating to all three research objectives.

- Questionnaires to the pre-service teachers (the students)
- Interviews with the course instructors, the English teacher, and with selected students
- Reflections by the researcher and course instructors
- Content analysis of artefacts developed by the student-pupil groups – such an analysis was attempted but proved far too subjective to be used as a reliable method for “inferring backwards” (from the artefacts to supposed underlying processes)

Research questions

1. How do the various players perceive the connections between the systems?
 - a. What connections do the course instructors / the school English teacher / the pre-service teachers / the researcher see between the disciplines brought together in this case?
 - b. What connections do they see between the institutions brought together in this case?
 - c. How have these connections (cross-institutional, cross-disciplinary) affected the way the instructors / the English teacher teach and the way the students / pupils learn in this course / in other courses?
2. How do the various learning artefacts produced in this course point to cross-fertilization between institutions / between disciplines? What evidence is there for:
 - a. connections between disciplines in the artefacts themselves?

- b. transfer of conceptual to practice-bound knowledge in the artefacts developed by the pre-service teachers in their communications with the pupils?
 - c. changes in the way the English teacher teaches?
3. What is the pedagogical metaphor about teaching and learning adopted by the various players to characterize teaching and learning in this course / in previous similar courses / in other courses they are currently teaching?

Data analysis and conclusions

Content analysis of the verbal protocols (the interview data and the responses to the open questions on the questionnaires) using Narralyzer allowed a categorization of the verbal records according to: indicators of inter-disciplinary and cross-institutional cross-fertilization, absence of cross-fertilization, and a characterization of the cross-boundary context according to the communication setup, the roles of the various players, and the credos of the teacher trainers, the school English teacher, and the students (the pre-service teachers). The context, and the interplay between features of the context, can be seen to explain the presence or absence of cross-fertilization.

The content analysis of the interview and questionnaire data helps to identify aspects of the activity that yielded cross-fertilization and aspects that did not, and to characterize features of the cross-boundary context that may have contributed to processes of cross-fertilization or that may have impeded these. The three most important features of the cross-boundary context emerging from the data analysis are:

- the communication setup within the teacher team, including the communication between the college team and the school team, and the communication setup between the students (the pre-service teachers) and the pupils;
- the ways in which the various players define their own roles and those of the other players involved in the activity, highlighting the importance, both of reaching agreement regarding role definition and differentiation, and regarding fluidity between roles where necessary, with a balance between role differentiation and "role crossing";
- the necessity for discussing conflicts that emerge during the activity in terms of the credos about teaching and learning in general and in relation to the specific disciplines involved.

UniNe: “The Russian Dolls” Model in the Teaching and Learning of Music

Short case description

This scenario in music education is developed to target 4 different populations (pupils, pre-service teachers, in-service teachers and the Ph.D. researcher) and levels of action. The pedagogical setting has actually 4 layers which are intertwined according to the different roles taken by the researcher. The case happens in different locations (Switzerland, Canada, Latin America).

Procedures are developed to offer possibilities for the teachers to decentre from their own understanding of the activity (situation, tasks, operations, tools, concepts, notations, musical reality, etc.) and to get a grasp at the learners' perspectives, eases and difficulties. It is expected that this will lead to a better understanding of the multidimensionality of music (incl. music creation) and of the complexity of the teaching and learning/creation process.

The structure of the scenario is made of 4 interrelated studies. The researcher, Marcelo Giglio, is the main researcher. He takes different roles in the different studies:

- In the study no1, the researcher, Marcelo Giglio, acts as a researcher and a music teacher who designs lessons and teaches them to his pupils in primary and/or secondary schools.
- In the study no2, the researcher is a researcher and a pre-service teacher trainer.
- In the study no3, the researcher is a researcher and he works with other in-service music teachers in training.
- In the last study, the researcher is a PhD. student who works with his director of thesis (Anne-Nelly Perret-Clermont).

First level scenario (pupils)

In the study no. 1, the music teacher (Marcelo Giglio) designs didactical sequences (for instance: the discovery of rhythm). A sequence has this kind of structure: the teacher first gives basic information on rhythms to the pupils. They are then grouped in triads and have to compose a rhythm. Afterwards they perform collectively in front of the other pupils. The teacher then asks them to recall how they have come to this rhythm and how they have managed their social relationships in order to get organized to perform it. The next step is the presentation by the teacher of information and considerations on how to improve their skills and performances and in particular to write down their rhythm to be able to remember it. Students are very active and creative in music creation, also thanks to the teaching which makes this possible. However for the teacher the results are often different from what he expected.

To try to face up these discrepancies, in this pedagogical design, the teacher not only teaches but he also observes if what he intends to do is what really happens. So he predicts (and writes down in his personal diary) first as far as possible what he expects the children will do and what difficulties he expects them to face. Then he does his teaching and videotapes it and the pupils' activities.

After that, he looks at the video, and takes notes of what he observes. So he can confront what he sees with what he had expected to see.

Second level scenario (the trainer as researcher and teacher)

In the study no. 2 the pattern is the same, but this time, the music teacher M. Giglio is a pre-service teacher trainer in music. He teaches the didactical sequences he has created to his students who are teachers-in-training who will have to teach themselves the sequence later on. He asks them as well to confront their teaching the same way he does. He asks them to write their expectations, then teach the didactical sequences to their pupils when they are in internships, if possible to record the teaching lesson and to look at the video and confront their observations and their expectations. Finally M. Giglio and his students discuss the results. On the other side, the researcher, Marcelo Giglio, does the same for himself: he writes down his expectations regarding his pre-service teachers' accomplishments, records his interactions with them and confronts.

Third level scenario (with teachers in training)

In the study no. 3, M. Giglio works here with colleagues who are experienced in-service music teachers. He does not have the role of the trainer, but is considered to be an expert. He and his colleagues work in a collaborative way on the didactical sequences according to the same pattern (expectations, performance, confrontation and improvement of the didactical sequence).

A lot of different tools are used according to the different issues: produce music - record - observe - share. There are audio and video recorders, beamers, loud speakers; textual materials; music materials (any kind of instruments that can produce sound like the pupils' own body, keyholders, boxes, musical instruments; they have paper and pencils, etc.); electronic platforms (Educane2 and Moodle) for storing and documents, music productions; discussing experiences, etc.; a mapping tool for the production processes.

Research questions

1. How can the confrontation of the teacher's pre-conceptions and what really happens in the teaching contribute to make tacit knowledge about teaching/learning more explicit, to discover obvious misconceptions and unexpected complexities, and work on them for more efficiency to reach the goals set?
2. Can pedagogical situation for the teaching of music be designed to help the pupils develop more epistemic agency?
3. How can the use of ICT tools help develop the awareness of music, creativity, teaching practices, group coordination in music production, learning difficulties, etc.?
4. What is the impact of recording students' music productions?

The aim of this "telescopic" case is to elaborate on existing knowledge practices. The above described process of observation and then modification of the practice is iterative. The knowledge practices that are elaborated are then tested, modified, retested.

Data analysis and results

First general results

Usually there is a discrepancy between expected results and what really happens. The analyses (in progress) of these discrepancies are very informative and encourage new elaborations. Each level gives the opportunity to work and elaborate on the existing knowledge practices.

First lessons learned

First of all a very good planning and technological organization is needed to manage students, production, recording, tools, platforms, time, etc. The second aspect concerns the fact that training is required to help teachers be very precise in their predictions and observations: they need to learn how to be precise, because if they are not their observations are not true observations but rapid inferences, and the risk is that they "observe" or "see" only... their own prejudices.

First results of the pilot study

The study was conducted in Switzerland in a secondary classroom. The study had for goal to observe if stimulating and accompanying the reflection of the pupils on their registered activity (on MP3) and to re-listen to it, improve their musical performance. Two groups were invited to share their reflexions on the question: "how did we do to succeed the musical improvisation?". All the comments were registered.

Data attest the influence of that common reflexion on the quality of the later musical production. This study shows then the importance of the common reflexion of the students in the progression in musical creativity.

It is a pity not having a tool that would permit to write directly what pupils do.

More results to come

First level scenario (pupils)

Until now, there has been a study in Switzerland, a study in Canada (Québec) and a study in Argentina (St Nicolas). The results are presently under analysis.

Second level scenario (the trainer as researcher and teacher)

The second study is finished; we are waiting to finish study no. 3 in order to make comparison.

Third level scenario (with teachers in training)

The third study ends in October 2007 with data from one class in Brazil, three classes in Argentina and two classes in Switzerland.

UniNe: Bilingual EducationShort case description

Elementary school teachers get their training in the HEP Fribourg (University of Applied Sciences in Pedagogy), in a 3-year course consisting of 6 semesters of general courses (lectures, seminars, reading) in psychology, education, didactics, arts, sport and music. The uniqueness of this training is that courses are given in two languages; French and German. During the 3 years, the students go through 8 internships in different schools, in the two languages. And at the end they write a bachelor's thesis. This training is oriented to the construction of professional competences such as: organizing and managing learning situations; observing and following learning processes; creating “differentiation’s” device; using media and ITC, etc.

Research focus

The training is oriented towards the construction of professional competences by integrating theory and pedagogical practice during 3 years in which the student teachers do 8 internships in different schools. The focus is to examine the training in this specific bilingual context to gain information about the specificity of the knowledge practices in teacher training.

Research questions

How can the introduction of ICT tools help to bridge the gap between theory and practice (in particular during internships)?

Data analysis (still ongoing)

The following data sources are used:

- Pre-questionnaires given to the students to get their opinions and representations on the device.
- Short study on the mentors: the relationships between the novices and the experts; an analysis of some interviews done with students.
- Analysis of official documents: of the monolingual device and of the bilingual device.
- Analysis of the content of the “Integration Days”.
- Analysis of some of the DAP: the content on a longitudinal standpoint; the representations of the students through interviews.
- Analysis on the training of the mentors.

The empirical work in this case will give us an overview of the state of the teacher training in relation to:

- the tacit knowledge of the students, and also of their mentors;
- the gap between theory and practice and how this has an impact on the knowledge practices of the parties involved.

PA 4: Creating teacher networks that foster professional transformation

ELTE: Multi-grade Teacher Community

The site at which the case is conducted: Eötvös Loránd University, Faculty of Science, Budapest, and 18 (Phase 1), 4 (Phase 2) multi-grade primary schools in Hungary

Short case description

Multi-grade schools are small village institutions where primary school students of two or more grade levels are taught simultaneously in the same undivided learning space. An international survey of such institutions in five EU countries showed that at present, methodology for this unique but not rare learning situation (600 school in Hungary, thousands in Europe - does not differ significantly from traditional grade based education (cf. www.nemed.org). Communication, however, is restricted and mostly written, and teaching methods other than frontal instruction are very rare. This longitudinal study investigates the effects of the enhancement of verbal and visual communication skills on learning performance, motivation, self-esteem and general learning to learn skills in primary education as well as in-service training of teachers in multi-grade schools. Teachers are trained in ICT supported verbal and visual communication methods and co-construct learning programs targeted towards a new multi-grade pedagogy in Mathematics and interdisciplinary Arts Education. Both learning programs involve intensive use of ICT tools with special attention to remedial education preceded by general training in basic digital literacy skills. Professional and disciplinary boundary crossing involves role shifts from teacher to mentor of peers and curriculum developer, and from discipline-based to interdisciplinary methodology. The mentored innovation paradigm successfully employed in low SES learning communities by ELTE is enriched by triological learning principles outlined above in a “training through innovation model” that intends to bridge the theory-practice divide in the context of professional training.

Research questions

1. How does collaboration in teaching and learning in the creation and use of new knowledge artefacts enhance the development of verbal and visual communication skills of teachers and learners?
2. How can the mentored innovation model enriched through triological learning principles contribute to the restructuring of epistemic agency of teachers?
3. How does the triological learning process contribute to equality in education? Does it help reduce the negative effects of social handicaps? Does collaborative knowledge construction of teachers, community members (parents and other educational stakeholders) and teacher trainers enhance learning motivation, collaboration skills and self-esteem of learners?

Research approach and methodology

The project started with a needs analysis survey in September - October 2006. All Hungarian multi-grade institutions (600) were approached with an invitation for an ICT based educational training at ELTE. 220 institutions responded positively and 90 were invited for in an introductory training and needs analysis of teachers, students and community stakeholders. (Questionnaires and structured interviews were employed to investigate special training needs of multi-grade teachers and structure of their epistemic agency.) Communication and mathematics skills and competences were selected as survey participants highlighted

enhancement of communication and numerical skills as most relevant life skills for students in prepilot surveys and yearly national student learning assessment results of this school type also showed an urging need for improvement in these areas.

A sample of 18 schools was selected for pre-pilot in-service training and innovative teaching experiment (November 2006 – June 2007) that represent average Hungarian multi-grade schools in infrastructure, SES status of students and staff ICT competence. In a blended learning course accompanied by school based tasks with tutor and peer mentoring, teachers were invited to analyze and reflect on their pedagogical practices and through innovation, arrive at concomitant changes in epistemic agency (pedagogical metaphor as well as assessment practices).

Data analysis and conclusions

1. *How does collaboration in teaching and learning in the creation and use of new knowledge artefacts enhance the development of verbal and visual communication skills of teachers and learners?*

Significant improvement in verbal and visual skills and creativity was measured by a pre- and post hoc assessment design (*Test for Creative Thinking, TCT*, Urban and Jellen, 1986, and *Visual Narrative Test, VNT*, Wilson, 1997), social skills and self-esteem (*Operant Motives Test, OMT*, Kuhn and Scheffer, 1999). As these competences are considered highly important for life long learning and generally associated with the home, the program significantly contributed to equality as it furnished skills found lacking because of failing parental support.

2. *How can the mentored innovation model enriched through triological learning principles contribute to the restructuring of epistemic agency of teachers?*

Results of mentored innovation were assessed through semi-structured interviews and evaluation of pre- and in-pilot teaching programmes and self-developed teaching aids of teachers. A portfolio method of assembling, sorting and assessing longitudinal student development was also employed to reveal changes in epistemic agency. Pilot results show that team teaching methodology and group based, partly on-line in-service training facilitates catalyzed significant changes in underlying epistemological approach and helped teachers make the transition from individual learning to collective cognition and collaborative learning.

3. *How does the triological learning process contribute to equality in education? Does it help reduce the negative effects of social handicaps? Does collaborative knowledge construction enhance learning motivation, collaboration skills and self-esteem of learners?*

Through mentored innovation, peer support and local community involvement, teachers who felt inferior to “unigrade” (traditional, one grade per classroom) school staff, left out of most training and research opportunities (and thus became “professionally handicapped”), were encouraged to act as innovators and profoundly modify methods of instruction.

Teachers engaged learners in collaborative knowledge construction in multi-grade , multilevel groups instead of passive consumption of the learning material in grade based instruction and thus improve their communication and learning to learn skills as well as mathematical knowledge. Collaboration skills were measured through *student and teacher blogs*. Blogging was found an authentic and rich in verbal and visual data instrument for documenting the process of community formation among teachers and trainers, trainers and community, learners and teachers. Training and mentoring methods to enhance this process were detected in the pilot and will be further developed in Phase 2, when 4 schools will be selected for an in-depth case study of multi-grade learning community formation and networking among institutions.

ELTE: Teaching of Authentic English through Communication Based ICT Tools (EFL)

The site at which the case is conducted: Eötvös Loránd University, Faculty of Philology, Institute for English and American studies

Research focus and questions

1. The International English Teacher Community fosters crossing boundaries between educational and professional communities and national pedagogical cultures. Research focuses both on the integration of technological tools within teaching practice and the development of epistemic agency.
2. Analyzing the transformation of individual and collaborative knowledge practices in order to assess transformations taking place in networked activities. (Units of analysis in knowledge creation processes: individuals and communities and (inter)national networks that support dialogical processes over long-term.
3. Using e-mail and forum as a medium, we collect data (written interactions) about collaborative practices and activities, make discourse patterns visible and monitor potential change of teachers' behaviour from "individual professionals" to "professional team-players".
4. Prove our hypothesis that in order to achieve a symmetric knowledge development – in educational settings as well – instead of a one-directional flow of knowledge a collaborative knowledge acquisition is preferable. The communicative medium of online forums will be a crucial element of the collaborative learning environment and is assumed to contribute to fostering the knowledge creation to a great extent.

Short case description

In the pre-pilot, pedagogical scenarios involving boundary crossing and cross fertilization (teacher – student – researcher) were developed. These will be further elaborated and examined in relation to current international practices and evaluation results findings of the pre-pilots. We will follow a number of courses focused on fostering boundary crossing between educational and professional communities.

In order to ground the insights from our case analyses in actual practice, we have established a domain-specific Teacher Community, the international English Teaching Workshop. The participants include a group of in-service teachers (trained EFL teachers who have been working in Hungarian grammar schools), pre-service teachers who are being trained to become professional EFL teachers, a teacher trainer and a pedagogical researcher who is a PhD student at the same time. We plan on combining these populations in order to encourage cross-fertilization.

How technology tools are used

Analysis of group interactions in relation to group knowledge construction in online collaborative learning environments will be undertaken with the use of the following tools:

Analysis of transformation of individual and collaborative knowledge practices in order to assess and measure transformations taking place in networked activities will involve **MapIt**.

Online learning programmes will be hosted in a **Moodle** environment. **FLE3** will be used for sharing authentic problems between knowledge practices. Both VLE-s will be utilised for monitoring the knowledge-building processes (argumentative form).

Data analysis and results

The focus of evaluation in this case is multi-layered and the analysis framework includes both quantitative and qualitative research tools.

Quantitative data

The first constituent of the multi-dimensional evaluation framework is the ICT competence of the pre-service teachers. We used a piloted *ICT competence test*. Accordingly, the data gained from this competence test will be an essential part of the Case3 evaluation procedures.

The second evaluation tool is also a questionnaire. The Course Participant Satisfaction and Communication Questionnaire includes items from piloted surveys of Picciano (2002); Richardson and Swan (2003) and Swan and Shih (2005). It focuses on the following factors which are considered to be essential for the evaluation of online collaborative learning:

1. General background information of the course participants
2. Participant satisfaction
3. Collaborative learning
 - a. Role of the facilitator
 - b. Group work in an online community
 - c. Online communication and interaction
 - d. Social presence

The third dimension of the quantitative data analysis is the analysis of the log files:

- Frequency of log-ins – participant activity
- The amount of messages sent in the forum
- The direction of messages (social network analysis (density, centrality), interactivity graphs)

Qualitative data

Qualitative data are gained from the participants' online interactions in the forum. The interaction analysis will be carried out on the basis of the theoretical framework of content analysis of Henri (1992) supplemented by the coding system of Zhu (1998) and Bloom's cognitive domains (1956); and the interaction analysis framework of Gunawardena et al (1997) by two evaluators.

PA 5: Developing capabilities of transformative learning and knowledge management in work places by reflective tools and practices

UiO : Wiki in English as a Foreign Language (EFL)

Short case description

This case is based on a one-year English as a Foreign Language (EFL) unit in the Norwegian curriculum for upper secondary school. The teacher is engaged in practice with a class of learners where a Wiki was introduced in two writing projects. Text production enables all the participants to contribute, revise, and delete. The case focuses on the aggregated and collective hypertext that emerges as a result, and examines what kind of activity types learners engage in, and the role of the teacher in such a collective and networked learning environment.

Main Goal

To advance the kind of epistemic agency and collaborative knowledge creation that add up to

triological learning by the introduction and advancement of a collaborative authoring tool, i.e., a Wiki. Also (in a second phase), addressing the teachers' role in fostering collective cognition and advancing teacher education to address the epistemological conflict between individual ownership of written work and the Wiki's collective epistemology.

Research focus

Advancement of wiki software based on Xwiki open source application (spaces for teacher, affordances for prompts and categories to support learner production and using more than one shared space). Need for a combination of wiki design and an analysis of activity structures in a wiki environment to bring about productive practices, more specifically (in a second phase): a) change in task that takes collective problem solving as a starting point, b) change in teachers practices into a more active and persistence teacher presence, c) change in time, space and pace.

Research questions

1. How can we develop guidelines for working with a wiki application to so that it facilitates teachers' boundary crossing between co-located and virtually distributed activities?
2. How can we develop pedagogical designs that are conducive to orchestrating learners' as well as teachers' efforts towards knowledge advancement?

Data analysis and results

From our research (Lund, 2006, 2007, 2008; Lund & Smørđal, 2006) we have identified the need to design and develop tasks that lend themselves to wiki environments. We base this claim on observed and analyzed wiki activities represented in the model that follows (Figure 1, next page). This model represents wiki activity from task to outcome, with crucial stages in between, and solutions that may be mutually constitutive of knowledge advancement in a wiki.

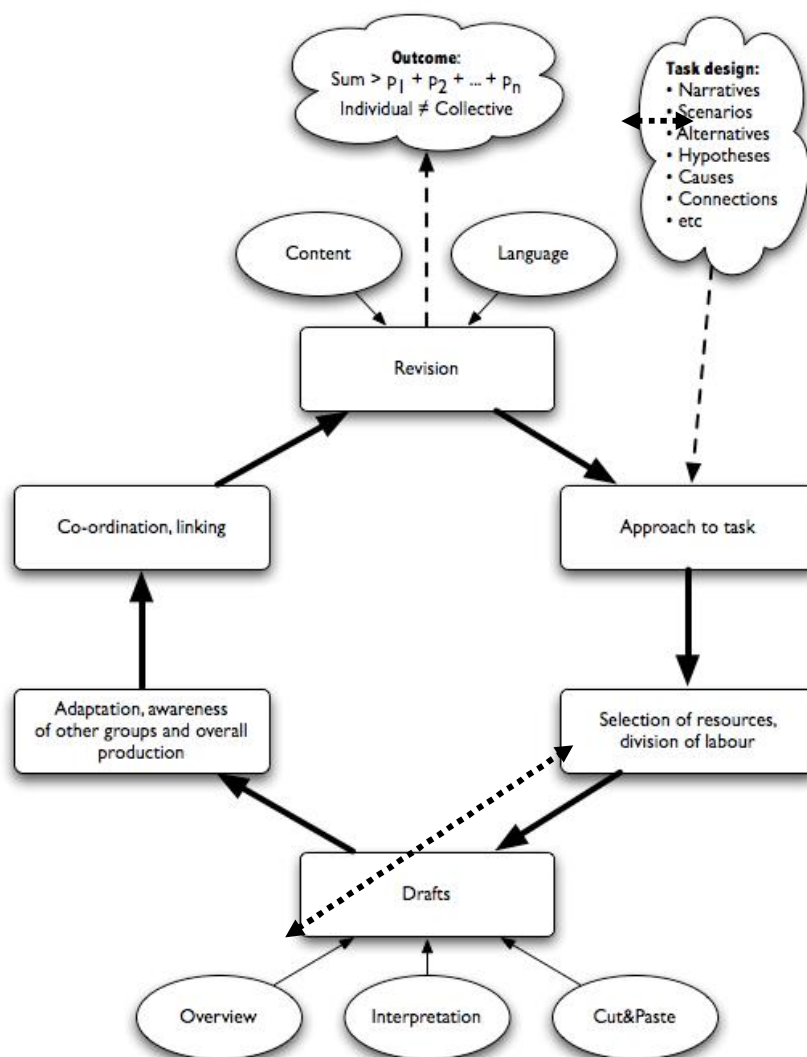


Figure 1. Connections between tasks, activities, and tools in wiki projects

The model poses a dramatic challenge for teacher support, participation and intervention in order to assist in knowledge creation with and through dialogical tools. This model emerged as a result from two wiki projects in EFL, level K11 (17-year olds). It shows how learners worked from approaching the task, how they selected resources, divided work between themselves, and constructed drafts where often material copied from the internet served as raw material for getting an overview and producing draft texts. The two rounded boxes on the left hand side show where learners, individually and in small groups, ideally develop awareness of work by others and align and coordinate their own work with that of others and the emergent wiki content. This happened by interlinking, revisions and sometimes by using meta-features such as discussion space for pages. The dotted two-way arrow that connects learners' approach to task with awareness of others, represents a crucial aspect of work in wikis. How to give support for such awareness so that a collective working mode is established early on in the knowledge advancement process is a fundamental challenge. To achieve such superordination there is need for technical features that afford peer interaction and monitoring of collective content development as well as opportunities for teacher interventions.

The MediaWiki application <<http://www.mediawiki.org/>> was used, which is basically one open space or resource where all contributions are placed and interlinked where relevant. In addition, it offers meta features such as the history of a page with rollbacks and comparisons

as well as talk pages that afford discussions of page content and various banners that categorize contributions as stubs, contested material etc.

The world of work and professional development as well as educational systems increasingly makes use of flat structures in and across small or larger groups. Such groups often work on projects of a multifarious nature and that draw on several knowledge domains (boundary crossing) and by using increasingly sophisticated technologies. The traditional hierarchical structures with clear-cut command lines and delineated tasks are challenged by networked expertise. This situation requires an educational discourse, activities and designs for learning that reflect such networked literacy. While learning Management Systems to some extent have taken care of the managerial aspect of such literacy and expertise, wikis seem to hold more potential for the actual learning and for knowledge advancement, for going beyond what we currently know by affording multiple and heterogeneous perspectives to construct an aggregated and perpetually refined learning object.

Conclusions: transformation/innovation

In the wiki case we have identified assignments or tasks as one very important key to bring about knowledge advancement practices. Transforming (bluntly put) individual knowledge acquisition into collective knowledge creation cannot be understood, much less be done, if we do not see this demanding situation in light of Vygotsky's methodological approach of double stimulation. If there is no logical coherence between the stimulus-object (problem, task, assignment) and the (series of) stimulus-means (cultural tools), participants will stick to traditional activities that demand minimal effort. In other words, if the task can be solved on an individual level, it will be.

In the wiki case the teacher has been active in developing tasks for knowledge creation and providing input for wiki development. We see this work as a contribution to teachers' professional development, development needed for teachers to cross boundaries between local collaboration and distributed collectivity, between contexts with various resources, and to assist in knowledge advancement practices. In this pedagogical perspective we see transformation as well as innovation in didactics (designs and support for knowledge advancement), technology (designs that afford technical as well as social prompts), and theory (object-orientation of collectives, theorizing tasks as primary stimulus).

References

- Lund, A. (2006). WIKI i klasserommet: individuelle og kollektive praksiser [WIKI in the classroom: individual and collective practices]. *Norsk pedagogisk tidsskrift*, 90(4), 274-288.
- Lund, A. (2007). ICT and EFL: What can we *now* do with language? *Språk og Språkundervisning [Language and Language Teaching]*(2), 30-36.
- Lund, A. (2008, accepted). Wikis: a collective approach to language production. *ReCALL*.
- Lund, A., & Smørddal, O. (2006). Is There a Space for the Teacher in a Wiki? In *Proceedings of the 2006 International Symposium on Wikis (WikiSym '06)* (pp. 37-46). Odense, Denmark: ACM Press.

PA7: Developing technology-enhanced practices for scientific writing

UU: Characterization of Knowledge Practices during Scientific Writing in Web-based Learning Environments (WebLE)

Short case description

In this case we investigate aspects of students' object-related activities and reflective practices during the course Web-based Learning Environments (WebLE). The course is a 10-week second-year bachelor level course at the Department of Educational Sciences, Faculty of Social and Behavioural Sciences. This course was designed employing design principles that are based on the knowledge creation metaphor of learning (Paavola, Lipponen, & Hakkarainen, 2004). In this approach to learning, the focus is on the creation of new knowledge through the construction of shared artefacts, with this process itself also being an object of reflection. For our course, this means that students' learning activities and the object of reflection are equivalent: collaborative learning mediated through collaborative computer-supported tools. This means that students learn about how these tools may support learning by conducting and reporting on a small-scale study which focuses on how students learn using these tools in collaborative settings.

In *WebLE*, all the object-related activities performed by advanced students in Educational Science are collaborative in nature and simulate collaborative scientific writing practices. During this course, students collaboratively generate a report about a small-scale study they have conducted within the domain of collaborative learning supported by computer tools. Students are to produce this research report in groups of three or two, using their understanding of scientific literature, their self-guided research interests and their experiences with collaborative computer-supported tools to design and subsequently perform their study. Authentic practices are reflected in the fact that students will go through an iterative cycle of progressive inquiry in which they negotiate and decide on a research plan, read relevant scientific literature, design and conduct their study, analyze their data, and write their research report in which all elements are integrated. The process of conducting and reporting on a study present student with a rather complex task, therefore students are encouraged to collaborate with educational scientists and other professional experts during their research. The design of support for students during the course follows a general evolution in pedagogical scenarios, as described in Andriessen, Baker and Suthers (2003), from transmission based (understanding information), via studio-based (information sharing), to knowledge negotiation (developing new insights and knowledge).

The course is presented in a blended set-up (face-to-face meetings and online learning sessions), related to the main objective of the course. Students complete the course by delivering a scientific research report about how collaborative computer-supported tools can support learning. In addition, the groups are required to present their research to the other group(s) to engage in a critical discussion and reflection on the activities performed. To foster negotiation and discussion, students are told that the report must contain:

- a) A scientific justification and relevance for the research question(s) students attempt to answer in their study;
- b) A systematic account of the research method(s) used and analyses performed;
- c) A structured and coherent description of the research findings;
- d) A concise conclusion containing the answer on the research question posed.

Students are supposed to be engaged in discussions, using collaborative computer-supported tools themselves, and these discussions are fuelled by their growing knowledge of scientific

publications about CSCL, argumentation, and the use of graphical software for the support of collaboration and learning. Any initiative for changing the direction of the research report is welcomed, but requires negotiation to be implemented, with the other students as well as with the tutors of the course. The report is written collaboratively, with shared responsibility of students as well as tutors. During this process, students may assign roles and responsibilities for each activity.

Research questions

1. What object-related activities and reflective practices characterized students' progressive inquiry?
2. How did tutors foster students' progressive inquiry?
3. What was the role of the computer-based in supporting students' progressive inquiry?

Research approach and methodology

The course started with four students participating who split in two groups each with their own research topic. The first group focused on investigating the role of representational support in argumentation and the second group attempted to examine the effect of communication mode (i.e., synchronous chat versus asynchronous forum discussions) on the quality of argumentation and communication. However, the second group left the course which could mainly be attributed to their expectations being different from the course requirements in terms of the nature of the work to be performed. Therefore, the study focuses on analyzing the first group and the support provided by their two tutors.

An in-depth case study will be performed employing qualitative methods on the following data that was collected: pre-questionnaires that were contextualized to this particular course (categories: understanding and expectations of the course's purpose, prior knowledge of the domain, aspects of collaboration, epistemic agency, working on shared object, and tool usage), video recordings and observations of the interactive lectures provided by the students' tutors, audio recordings of students' meetings, the produced artefacts that were placed on the Blackboard system, e-mail correspondences, and semi-structured interviews with students and their tutors.

As an approach, we tend to perform qualitative methods employing mainly ethnographic methods to identify patterns in the data. In addition, triangulation was applied to gain an elaborate insight into these patterns but also to substantiate particular inferences made. To describe and conceptualize these patterns we made use of premises inferred from the theoretical frameworks of activity theory, triological learning and progressive inquiry. Main aim was to model (transformations in) students' activities that fed into the creation and development of their shared knowledge objects (i.e., scientific report on a small scale study). Object progression was investigated in two steps: first we identified what was said about the object or intermediate artefacts and subsequently we examined to which extent and how these ideas, activities or pedagogical conditions contributed to the advancement of their knowledge object.

Data analysis and conclusions

Conclusions are rather preliminary since data analysis is still being performed. In general, students were engaged in intensive discussions, also using Blackboard, and these discussions were fuelled by their growing knowledge of collaborative computer-supported learning as a result of reading and negotiating about scientific publications within the field of CSCL and due to students having experiences with the use of software for the support of collaboration and learning. These discussions were a source of reflection and progress, since they served to

create and advance their main knowledge object. Moreover, the creation and development of this knowledge object seemed to define the purpose of students' activities.

During the course students created several artefacts which supplied relevant material for their knowledge object, such as the research proposal, research planning, ideas about research methods and preliminary versions of their research report. The extent to which students invested effort in working on these artefacts depended on how they valued their function in the process of advancing their research report. It has to be noted that all artefacts were dynamic in the sense that their structure and roles continuously changed during the process.

Artefacts students created served to direct discussions, and fostered elaboration and explanation about domain knowledge, which can be characterized as processes of knowledge creation. In addition, students indicated that the open nature of the activities they performed led them to acknowledge the idea that they were advancing their own knowledge instead of producing objects in service of course requirements. Being actively engaged in and responsible for the whole process of conducting and reporting on research within the field of CSCL fostered students understanding and skills involved in the process of scientific inquiry.

Students' activities can be characterized according to three overlapping phases identified in their project work:

1. Problem statement and domain understanding

To direct their main activity, students were asked to write a research proposal containing the problem statement and a provisional planning of their study. To support students in their thinking and writing of this proposal, they were offered the possibility to consult several scientific articles considered to be central in the field of CSCL research and that were uploaded on the Blackboard tool. Tutors asked students to reflect on these articles and react to leading questions with the aim of coming up with first ideas for research questions. In addition, tutors presented students with a number of CSCL environments (i.e., VCRI, DREW, FLE3 and KP-Lab shared space). Based on these experiences, students in groups decided upon a research question and delivered a research proposal. The research question and planning were subject to changes as a result of developments in students thinking which was reflected in and affected by activities that resolved around these artefacts, such as feedback received from the tutors, discussions, and research tools and methods chosen.

2. Designing and conducting research

In this phase students constructed and decided upon the design of their study (partially) according to the plans they had laid out in their proposal. In addition, the tutors encouraged students to search and process more scientific literature that provided the necessary background and substantiation for their research question. In an intensive collaboration, students performed the following learning activities in an iterative fashion: a) reading and processing scientific texts, b) designing materials for their study, c) revising research question(s) or plan, d) conduct their study, e) analyze the data, and f) write preliminary versions of their research report. During this phase students presented and discussed intermediate artefacts with their tutors at either face-to-face meeting or by means of the Blackboard system. In addition, groups exchanged results, materials or methods to reflect upon each others activities. This phase involved a great deal of elaboration from students, since they had to integrate, to translate and to critically reflect upon their own understanding, scientific understanding, research methods and analyses, and research findings.

3. Synthesis: collaborative writing of research report and presentation

Prior activities provided essential material for students to continue creating their research paper, in other words students' evolving knowledge creation practices that was mediated by

constructing of artefacts fed into the main activity that is the creation of their knowledge object. The artefacts students already created can therefore be conceptualized as tools used in the process of creation their research paper.

However, tutors indicated that there should be more focus on transformation of students' practices through the reuse of artefacts, in addition more emphasis should be placed in critical reflection on the process by means of which artefacts are created. This involves the idea of cognitive traces to some extent: students have to more explicitly report and reflect on how they achieve new insights, and give other students the chance of discovering the same. In addition, students indicated that they could have performed a study of higher quality when their research questions were clearer and more precise from the start, but that their efforts were restricted given the complex nature of conducting and reporting on an empirical study in combination with the time pressure put on students for delivering the report within 10 weeks.

References

- Andriessen, J., Baker, M., & Suthers, D. (2003). In J. Andriessen, M. Baker & D. Suthers (Eds.), *Arguing to learn: Confronting cognitions in computer-supported collaborative learning environments*.
- Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Modeling innovative knowledge communities: A knowledge-creation approach to learning. *Review of Educational Research, 74*, 557-576.