Principles of Progressive Inquiry

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The present paper is prepared as background material for the Inquiry-based learning course in EAHIL 2008 as a short presentation of the pedagogical model of Progressive Inquiry.

An introduction to Progressive Inquiry

A central aim of present-day education is to prepare learners for the emergent knowledge society through appropriate pedagogical practices; it is not enough to concentrate on content mastery in some subject domains but to provide students with the skills of knowledge creation and problem solving. Pedagogical practices that are regarded to improve these abilities include such features as student ownership and active involvement; collaboration between participants; activities of searching, sharing and elaborating knowledge; working with authentic, ill-defined problems; critical reflection on one's own activity; and the teacher's changed role from delivering knowledge to organizing, guiding and assessing students (Kozma, 2003; Scardamalia & Bereiter, 2003).

Several researchers have proposed that in order to facilitate higher-level knowledge processes in learning, cultures of schooling should more closely correspond to cultures of scientific inquiry (e.g., Carey & Smith, 1995; Collins *et al.*, 1989; Perkins *et al.*, 1995). This includes contributing to collaborative processes of asking questions, producing theories and explanations, and using information sources critically to deepen one's own conceptual understanding.

By synthesizing these demands, Kai Hakkarainen and his colleagues in the University of Helsinki (Hakkarainen, 2003; Muukkonen *et al.*, 2004) have developed a model of *Progressive Inquiry* as a pedagogical and epistemological framework to support teachers and students in organizing their activities for facilitating expert-like working with knowledge. It is primarily based on the theory of *Knowledge Building* (Bereiter and Scardamalia, 1994), on the *Interrogative Model of Scientific Inquiry* (Hintikka, 1999), and on the idea of *distributed expertise in a community of learners* (Brown & Campione, 1994). The model has been implemented and studied in various educational settings in Finland (e.g., Lipponen, 2000; Lahti *et al.*, 2003, Lakkala *et al.*, 2005, Lakkala *et al.*, 2007; Lakkala *et al.*, 2008; Muukkonen *et al.*, 2005; Veermans *et al.*, 2005).

Essential elements of the Progressive Inquiry model

In progressive inquiry, students' own, genuine questions, and their previous knowledge of the phenomena in question are a starting point for the working process, and attention is drawn to the main concepts and deep principles of the domain. Although students are learning existing knowledge, they may be engaged in extended knowledge-seeking processes of the same kind as scientists and scholars who create new knowledge. From a cognitive point of view, inquiry can be characterized as a question-driven process of understanding. Without research questions there cannot be a genuine process of inquiry although currently in school information is frequently produced without any guiding questions. The aim is to explain the phenomena in a deepening question-answer process where students and teachers share

their expertise and build new knowledge collaboratively with the support of information sources and technology.

The progressive inquiry model specifies certain epistemologically essential elements that a learning community needs to go through, while the relative importance of these elements, their order, and actual contents may involve a great deal of variation from one setting to another. In the following, a general framework of progressive inquiry is outlined and each aspect of inquiry shortly discussed (see Figure 1).

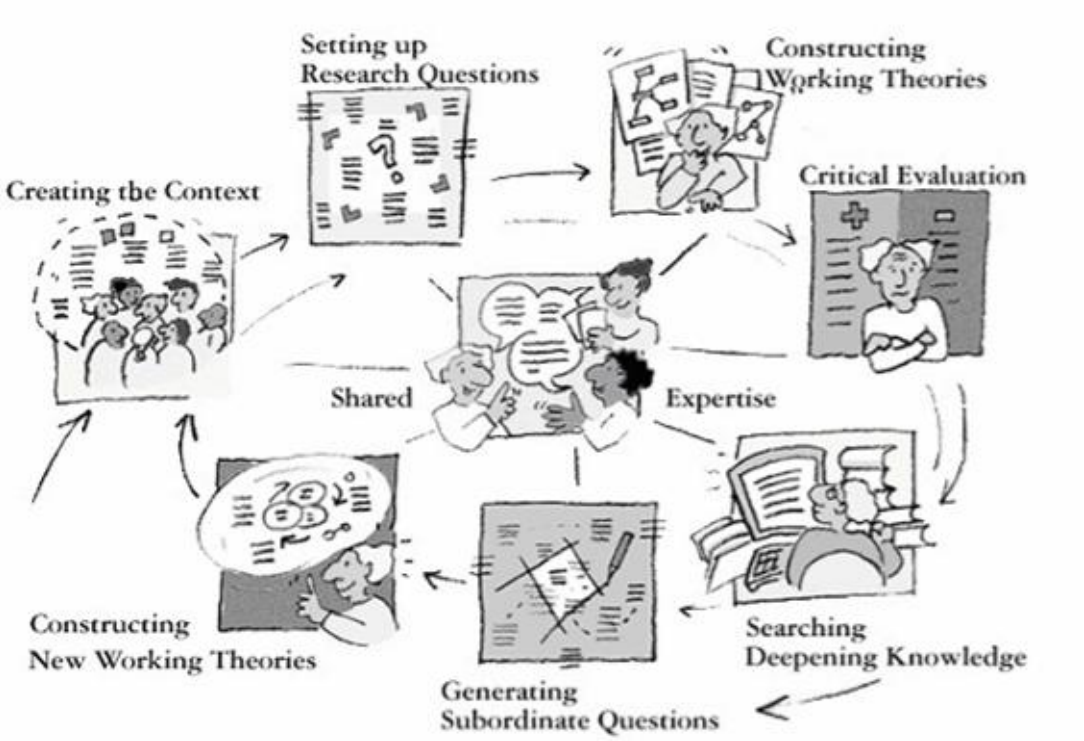

Figure 1: Elements of progressive inquiry.

Shared expertise: All phases of the process should be shared among participants, usually by using collaborative technology. Diversity in expertise among participants, and interaction with the information sources and/or expert cultures, promotes knowledge advancement. It includes shared cognitive responsibility of the success of the inquiry.

Creating the Context: At the beginning of the process, the context for the project is jointly created in order to anchor the problems being investigated in the central conceptual principles of the domain or complex real-world problems. The learning community is established by joint planning and setting up common goals. It is important to create a culture of learning that supports the collaborative sharing of knowledge.

Setting up research questions: An essential aspect of progressive inquiry is to generate students' own problems and questions to direct the inquiry. Explanation-seeking questions (Why? How? What?) are especially valuable. The learning community should be encouraged to focus on questions that are knowledge-driven and based on the results of students' own cognitive efforts and the need to understand. It is crucial that students come to treat studying as a problem-solving process that includes addressing problems in understanding the theoretical constructs, methods, and practices of scientific culture.

Constructing working theories: A critical condition for developing conceptual understanding is the generation of students' own hypotheses, theories, or interpretations of the phenomena

being investigated. It is important that students explain phenomena with their own existing background knowledge before using other information sources, and openly share these explanations in the learning community. This serves a number of goals: first, to make visible the prior (intuitive) conceptions of the issues at hand. Secondly, in trying to explain to others, students effectively test the coherence of their own understanding, and make the gaps and contradictions in their own knowledge more apparent. Thirdly, it serves to create a culture in which knowledge is treated as an essentially evolving object. Thoughts and ideas presented are not final and unchangeable, but rather utterances in an ongoing discourse.

Critical evaluation: Critical evaluation addresses the need to assess the strengths and weaknesses of different theories and explanations produced, in order to direct and regulate the learning community's joint cognitive efforts and the evaluation of the process itself. Critical evaluation is a way of helping the community to rise above its achievements by creating a higher-level synthesis of the earlier results of the inquiry process.

Searching deepening knowledge: Students are supposed to explore diverse sources of information to find answers to their questions. A comparison of intuitively produced working theories with well-established expert knowledge or scientific theories tends to make the weaknesses of the community's conceptions explicit. The information sources should be used in an elaborative and evaluative way instead of copying information as such. The teacher decides how much of the materials should be offered to the students, and how much the students themselves should actually search out for the materials. Questions stemming from true wonderment on the part of the students can easily extend the scope of materials beyond what the teacher has foreseen or suggested. On the other hand, the search for relevant materials provides an excellent opportunity for self-directed inquiry and hands-on practice when struggling to grasp the differences between various concepts and theories.

Generating subordinate questions: The process of inquiry advances through transforming the initial big and unspecific questions into subordinate and more specific questions on the basis of the evaluation of the knowledge produced. Formulation of subordinate questions refocuses inquiry.

Developing new working theories: New questions and the scientific and/or expert knowledge that the participants explore give rise to new theories and explanations. The process also includes the publishing of the summaries and conclusions of a community's inquiry. If all productions to the shared database in a collaborative environment have been meaningfully organized, participants should have an easy access to prior productions and theories, making the development of explanations a visible process.

Progressive Inquiry in practice

A typical progressive inquiry project in school or university can last 4-6 weeks, with 3-6 hours per week, but the elements of progressive inquiry can also be applied in shorter or longer learning periods. Usually, students work in groups of 2-4 students, having a common research question, but also the whole classroom has common discourse sessions face-to-face or on-line. The teachers' role in progressive inquiry is to organize the whole educational setting which includes, for instance, scheduling the process, planning the use of technology and learning materials, and organizing students' collaboration and group work. It is usually necessary for the teacher to structure and scaffold the process, keep it active and in focus during the progression of the course, and to help students gradually to take upon themselves the responsibility of the higher-level cognitive processes.

The pedagogical ideas of progressive inquiry can be applied in ordinary educational settings in classrooms, but it is mainly designed for the context of Computer-supported Collaborative Learning (CSCL). The pioneering work of Scardamalia and Bereiter (1994), in developing the CSILE environment as a tool for supporting collaborative knowledge building is a well-known

example of an inquiry-based approach to technology-supported collaboration in education. One of the main ideas in CSILE was the built-in scaffolds ("Thinking types") that represent the essential aspects of inquiry to structure and support students' explanatory process. The progressive inquiry model is in the same way implemented in an open-source collaborative tool called Future Learning Environment (FLE; http://fle3.uiah.fi), and in Synergeia-environment (http://bscl.fit.fraunhofer.de/) designed in the EU-funded ITCOLE-project (see http://www.euro-cscl.org/site/itcole).

In the following, there is an undergraduate university course as an example, designed following the ideas of Progressive Inquiry.

Case: University course in cognitive psychology

1. Basic information

Course Name: Psychology of modern learning environments

Institution: Department of Psychology, University of Helsinki

No. of Participants: 13

Target Population: Undergraduate students from various faculties of the University of Helsinki who took part in the course to complete a ten-credit minor unit in psychology.

Content Areas/Disciplines: Cognitive and educational psychology, educational technology

Duration of the Course: 3 months

No. of Instructional Hours: 24 hours face-to-face meetings (+ distance work)

The course was a 2-gredit undergraduate course in cognitive psychology in the University of Helsinki. The course was held in this form in the spring 2002. It was re-designed based on the experiences from previous courses (See Lakkala *et al.*, 2005; Muukkonen *et al.*, 2005) in order to put more emphasis on student-driven inquiry instead of lecturing, and to define the inquiry task more goal-oriented and collaborative by the requirement of a jointly constructed research report.

2. Goals of the unit

The course was organized according to the principles of progressive inquiry. The learning objectives of the course were

- To introduce students with the theories of learning as collaborative knowledge construction within the socio-cultural framework;
- To introduce students with the possibilities and research literature concerning the computer-supported collaborative learning (CSCL) approach;
- To model and give students an opportunity to experience the knowledge practices of scientific inquiry resembling the work of a research group.

3. General teaching arrangements

The course consisted of six seminar meetings (from three to four hours each), collaborative work within a Web-based environment between the meetings and a final meeting at the end of the course to evaluate the experiences jointly. The seminar meetings in the course were organized so that the first two hours were spent in a computer lab, and the following two as discussion and group work in a seminar room. Initially, the computers were used to practice the use of Web-based tools, but later the students worked with the computers in groups discussing and elaborating their group's inquiry work. A group of tree tutors were responsible for organizing the activities and guiding the students, taking turns in participating in the meetings. Important features in the arrangements were the following:

- Arranging the face-to-face seminar meetings flexibly using suitable timetable as well as computer lab and seminar rooms;
- No individual course credit (except 'pass') because it could disturb students' commitment to participate in the collaborative knowledge creation process;
- Students' final work assignment was the production of a collaborative report (which concretely creates a shared object to the student groups) in order to reach the goal of practicing collaborative knowledge creation.

The requirement for course credit was to contribute actively to knowledge creation and mutual commenting in seminar meetings and in Web-based environment, to participate in the construction of their own group's final report, and to write a self-reflection report at the end of the course.

The Web-based learning environment used in the project was FLE3 (http://fle3.uiah.fi). FLE consist of modules, from which the following two were used in the investigated courses: A user's WebTop (virtual desktop) and a Knowledge Building module. Each user has a personal WebTop where one can store knowledge items, such as documents, files and links, and arrange them in folders. Users in the same course can visit each other's WebTop and see its content. Also the shared "course folder" for each course is visible in each participant's WebTop. The Knowledge Building (KB) module provides a shared space, in the form of threaded discourse forums, for sharing and elaborating problem definitions, explanations and theories together by all the participants. The KB discourse is scaffolded and structured by asking a user to categorize each note by choosing a knowledge type (Problem, Working theory, Deepening knowledge, Comment, Metacomment or Summary) for the posting, corresponding to the progressive inquiry model.

Figure 2. An example of the screen view in FLE3's Knowledge Building module[1]

The students were provided with a lot of recommendations and links to scientific literature and other knowledge sources as well as guidelines and templates for organizing their collaborative inquiry process and report production. All materials were uploaded as documents or links in the shared working areas in FLE3.

4. Organization and monitoring of the working process

The first seminar meeting involved context creation by introducing the goals and themes of the course and explaining the Progressive Inquiry framework and how it would be used as a heuristic model to structure the inquiry process. In addition, all students told about their interests and questions on the course topic. After the first meeting, the students were guided to write an introduction of them, to post their initial problems and ideas of the course topic, and to comment on each others' postings in the shared area.

In the second seminar meeting, the problems created by the students were modified and classified by discussing them. Based on the joint discussion, three sub-groups (including four to five students) were formed according to selected research questions, based on the common interests of the students. Those research questions formed the main themes for the progressive inquiry process in the course, and each group was supposed to produce a jointly constructed final report of their group's inquiry results at the end of the course.

In the following meetings, the students elaborated the theories and ideas further in small groups by writing sub-ordinate research questions and better explanations (including

[1] The research problem stated in the open note is: "What will the roles of teachers and students be like in collaborative web-based environment compared to traditional classroom studying?". The thread continues with one student's hypotheses for the issue of roles, another student's comment to the hypothesis, and successive notes about how to activate students, motivating function of FLE tool, how to activate students with learning disability, activation and motivation in web-based environment, and student's role and motivation.

knowledge from scientific knowledge sources) and by commenting on each others' postings in a shared virtual space. Each small group had a task to pursue their group's research question further by using various knowledge sources and by together elaborating their explanations and successive versions of their research report.

The process was guided by three tutors throughout the whole course both in the shared virtual space and in face-to-face seminar meetings. Each tutor had a main facilitator's role of one group. At some phase, the groups were explicitly instructed to comment on other groups' ideas and drafts and in the last seminar meeting the students constructed a concept map about the main concepts related to their inquiry problem before they started revising the last version of their final report. One meeting included an expert lecture given by a professor in the field.

Before the last course meeting, the groups were guided to post the final version of their joint research report to the shared virtual space and other groups were encouraged to read and comment on them once again. In the last meeting, the whole process was evaluated together by sharing experiences and analyzing the group processes in a joint face-to-face discussion. After the course, the students wrote self-reflections about their participation in the course; those self-reflections could be used by the tutors to develop the course further and by the students themselves to evaluate their work in the course.

Concluding remarks

The progressive inquiry model has been developed as a guiding conceptual tool that helps teachers to engage their students in expert-like working with knowledge. The model captures certain essential aspects of the knowledge-creation process, such as importance of students' own questions and problems as a starting point, attention to main concepts and deep principles of the domain, engagement in deepening inquiry where the aim is understanding and explanation of phenomena, and socially shared process of inquiry. However, the progressive inquiry model only gives a generic approach on learning; each teacher's challenge is to transform these principles into functional educational practice in their own way.

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