

Distributed Collaborative Learning across Disciplines and National Borders

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Abstract: Networked computers and methods of distance learning are increasingly being used to meet the growing educational need for lifelong learning on flexible conditions. This paper reports on a cross-disciplinary and international collaboration between two web-based courses, which - each in their way - mirror an attempt to meet this need for flexibility in education: a Danish Distributed CSCL course from the Humanities on how to design teaching and learning in pedagogically appropriate ways using ICT-technology (i.e. the whole research area of CSCL), and an American mixed-mode CSCL course (on-campus and web-delivered) from the Sciences on global environmental issues.

The overall intention behind the collaboration has been "mutual learning" and the dissemination of knowledge across both disciplines and national borders. In very broad terms, the Danish course is an example of what it teaches, and the collaboration has brought a dimension of virtually based "practice" and of "reflection in practice" into the Distributed CSCL situation of the Danish students. As for the American course, some pedagogical aspects of the Global change course were evaluated using the pedagogical tools within the course itself, and the designers enjoyed the benefit of feedback from the Danish students on design, delivery and pedagogical techniques.

From the perspective of CSCL-technology, we intersected two ICT-tools within the cross-disciplinary, collaborative learning context (the web and videoconferencing) to explore their synergism.

Keywords: web, computer-mediated communication, evaluation

1. Introduction

Transcendence of constraints is at many levels a key element in the tapestry of expectations to the implementation of ICT in processes of collaborative learning: transcendence of the limitations imposed on collaboration through the parameter of time; transcendence of distances enabling global access to learning resources hitherto

unknown; transcendence of cultures connecting people across national borders, and transcendence of disciplines allowing for design of more holistic, problem-oriented processes of learning in virtual environments. "Learning Together Apart" (Kaye 1992, pp. 1) could be a suitable slogan for the expectation to learning through ICT now and in the future.

Distributed collaborative learning in virtual environments generally takes place through the learner's manipulation of symbols (e.g. text, graphics, pictures, video, etc.) (Sorensen, 1993). To establish a dimension of practice in virtual learning processes may be a complex task, which perhaps either requires the integration of CSCL tools (e.g. shared whiteboard, shared document tools, etc.) or the use of online simulation (i.e. virtual practice). But there is also the possibility of achieving a dimension of practice through cross disciplinary collaboration between courses.

This paper reports on the outcome of a cross-disciplinary and international collaboration between two web-based courses, which - in each in their way, as well as united - mirror an attempt (through the use of two types of ICT) to transcend and collaborate, not only across disciplines, but also across national borders, and to deal with the establishment of a dimension of practice in their learning processes: a Danish Distributed CSCL course - from the Humanities - on how to design teaching and learning in pedagogically appropriate ways using ICT-technology (i.e. the whole research area of CSCL), and an American mixed-mode CSCL course (on-campus and web-delivered) - from the Sciences - on global environmental issues. The collaboration has implied a transcendence of both geographical and conceptual borders. First, it has implied a transcendence of geographical borders, enabling knowledge dissemination and access to learning resources in a global sense. Second, the collaboration has implied a cross-disciplinary dimension. Finally, the collaboration has crossed also the strong and traditional borders between the Sciences and the Humanities. The following sections describe the collaboration and its outcome.

2. The collaborating courses

2.1 The Danish course

The Danish course was one of three courses (and one project work) in a one year distributed CSCL university education program (within the Humanities) for high school teachers and for people from the educational system of organizations, on how to implement, in pedagogically reflected ways, ICT in different types of learning processes. The one year education program was offered as continuing education on a half time basis.

2.1.1 Goals

To be able to integrate ICT in teaching and processes of development in appropriate ways, and - at a high level - to be able to guide and implement the use of ICT in teaching and learning as well as in other organizational contexts.

2.1.2 Content

The course dealt with the whole area of CSCL in the light of learning theory. In this way the course not only identified with the whole area of CSCL, but was also itself an example of what it was trying to teach.

2.1.3 Structure

The course - as well as the whole education program - was implemented on the Web, using the virtual environment "Virtual-U" (developed at the Simon Fraser University in Vancouver) under the auspices of the asynchronous learning environment. Each of the two semesters contained 2 physical weekend seminars at the university.

2.1.4 Pedagogical model

The pedagogical approach of the whole education program has been "Project-oriented Project Pedagogy" (POPP) (Dirckinck-Holmfeld, 1990; Fjuk & Dirckinck-Holmfeld, 1998). POPP has in fact been applied as the overall pedagogical approach of the entire university, across sciences in all teaching and learning activities. Within this pedagogical model the majority of activities take place as group activities (the exam as well) and resembles - to a certain extent - what in North-American countries is often called "problem solving" or "project-based learning" (Koschmann, 1994) in the sense that students work on projects and try to address the problem in a scientific (empirical) manner rooted in practice. There is one essential point, however, where POPP differs from problem-based learning: the group "owns" the problem, so to speak. In other words, the group itself has to find or construct the problem. POPP has its roots and ideology in the "critical emancipatory thinking" established in the 1970s. A very important element in this approach to learning is a dimension of practice.

2.2 The American course

The American course was a conventional course (within the Sciences) for senior undergraduates or beginning graduate students at a US university. It gradually has been migrated to a web base over the last 5 years, with new features being added as ancillary software has become available. We also have introduced learner-centered activities in place of or supplemental to conventional lectures.

2.2.1 Goals

(1) To help students come to an understanding of the interconnectedness of the global environment and the role of humans in charting (by design or default) its future trajectory, (2) to instill an appreciation for and recognition of authoritative literature on global-change issues, (3) to engage students within the course and across national and cultural boundaries in dialog on global-change issues, including ethical issues.

2.2.2 Content

The course encourages dialog on the human role of the change in our global environment by putting students in the role of policy makers in having to address the scientific, societal, political and ethical issues surrounding such issues as climate change, ozone depletion, deforestation, desertification, biodiversity, water degradation, and population.

2.2.3 Structure

The Global Change course consists of a sequence of learning modules on different global-change topics, each having evolved from a conventional university classtime period. Each unit has a set of objectives, summary information on the topic, student-submitted collaborative (2-3 students) summary of classtime discussion, "problems to ponder" as discussion starters for the electronic dialog, and extensive lists of web and other information on the learning module topic. Each unit has its own electronic dialog for student discussion among themselves and with outside experts or representatives of selected groups.

2.2.4 Pedagogical model

Students manage their interaction with the course and instructor through their personal (password protected) electronic portfolios (Taber et al., 1997). Pre-classtime electronic quizzes (available and automatically graded through the portfolio) require students to synthesize background material in preparation for classtime discussion. Student "ownership" of the course is encouraged through posting of student classtime summary discussion. Electronic dialog on individual learning unit topics is graded on the basis of both participation and quality of comments toward achieving unit learning objectives.

An authentic research-quality climate model allows students to learn by experimentation about physical processes occurring at the plant-soil-atmosphere interface. Over the internet, students pose questions, test hypotheses, execute numerical experiments, acquire tabular and graphical experimental results, and summarize results in either personal or group portfolios.

The course is viewed by the designers as a laboratory for experimenting with a variety of pedagogical techniques and initiatives (Taber et al., 1997).

3. The design of the collaboration

The whole collaboration was bridged on two learning technologies: The web and videoconferencing. As an initial focal point for the collaboration, we designed an exercise for the Danish students, working within the context of their course on ICT and pedagogical methods, to work also within the context of the Global Change course as a basis for evaluating its functionality and pedagogical methods. These evaluations were done by use of technologies used in both courses: portfolio from Global Change and videoconference from the Danish sequence course. Each student was issued a password-protected electronic portfolio as a launching point for exploring three features of the

course, namely the use of quizzes and class summaries for encouraging integrative thinking, use of simulations as a means of allowing open-ended hypothesis testing, and use of the electronic portfolio as a personal space ("room" or "office") for managing interaction with the course. Students used their portfolios to post their evaluations through both private comments to the instructors and through public postings by which they engaged in dialog with other students and instructors.

4. A meeting between pedagogical traditions

The collaboration between the Aalborg University course and the Iowa State University course has brought together two different pedagogical (instructional) traditions. Academic and pedagogical tradition and didactic approaches in North America (where in fact the virtual environment used in the Danish course is developed) within the area of open learning differ from the Danish in at least two ways. First, it is part of the American pedagogical tradition that the role of the designer and the role of the teacher usually are distributed on two different people. A division which is more easily applied and maintained with an accompanying stronger emphasis on learning as "instruction" with clearly defined tasks, techniques and didactics (Fjuk, 1998; Sorensen, 1997). This also counts for the interpretation of "collaborative learning". The pedagogical tradition in Denmark does not prescribe a division of roles in terms of educational design and educational delivery. Consequently, the designer and the teacher usually are the same person. Also, partly as a result of this, educational didactics have not been standardized, but left to the individual academic to decide upon. In this respect, the Global Change was an exception. Both design and delivery were carried out by the same team of people. This made the dynamic process of integrating learning processes in the virtual environment very smooth and fast.

At Aalborg University all teaching and learning activities (also the distributed collaborative learning concepts) are based on the specific pedagogical theory and understanding of POPP (see also section 2.1). This means, among other things, that the problem or task for study cannot be part of any prior implemented direct instruction, or formalized instructional technique. At a general level, the Global Change course was based on the pedagogical approach, which in North America is named "cooperative learning". It shares many features and techniques with "collaborative learning", but at the same time it also differs in the degree of sharedness of the activities and sub-tasks involved in the collaboration (Dillenbourg et al., 1995). Put in mathematical terms we could say that the pedagogical approach of collaborative learning is a true subset of cooperative learning.

5. Principled discussion of joint outcome

Transcending geographical and conceptual borders in collaboration and learning does not appear to be a simple task (Bates, 1995). Nevertheless, even with fundamental differences in pedagogical understanding and approach, the collaboration has spawned new and valuable insights into the development and use of general instructional principles, methods, techniques and applied technologies in design of collaborative

learning in virtual environments. The following discussion and evaluation of outcome of our collaboration will be approached mainly from the perspective of distributed CSCL. Consequently, although the mixed-mode Global Change course in principle covers two methodological sides in terms of design and delivery, it will be viewed and treated primarily from a distributed CSCL perspective.

5.1 Formalized techniques in design of asynchronous distributed CSCL

Some of the techniques used on the American course are as follows:

a) Quizzes

Extensive use of quizzes in learning was also part of the reservations on the Danish side against North-American instructional tradition. For many years they have been eliminated in Danish pedagogical thinking, but the collaboration brought them back into the light to be reviewed anew and realized that an important pedagogical potential had been overlooked and that learning could be supported in several ways using quizzes in reflected ways. In sum, quizzes that simply lead to recall of facts are of little value in long-term learning; by contrast, quizzes that require reflective thinking and synthesis of ideas spanning different topics can stimulate deeper thinking. Quiz results can assist the instructor in identifying issues that need additional attention. It should be pointed out, though, that constructing quiz questions that require synthesis is not easy.

b) Simulations

The Global Change course used simulations as ways for students to experiment with parts of the course content. Put in different terms we may view this as a way of incorporating a dimension of (symbolic) practice into asynchronous distributed CSCL processes. If we assume, from a learning theoretical view that recognizes the specific value of the dimension of practice as an important parameter in learning, that "simulated practice" has a value comparable to physical practice, then simulation techniques must be stated to have great value (as simulated practice in a virtual, symbolic world). The value of simulation is well recognized with types of areas that imply physical training and skills (e.g. training of pilots), but has so far not had the same status within areas that employ a high degree of reflection in learning (i.e. allowing students to explore over an infinite range of possible outcomes, to test hypotheses, etc.). In sum, simulations provide students with access to computer-based models that can be used both in the theoretical realm of hypothesis testing and in the practical realm of the decision-making process.

c) Collaborative action and interaction (dialogue)

The pedagogical value of the collaborative learning activities in the Global Change course, such as class summaries, appeared beyond any doubt. Posting of class summaries by teams of 2-3 students, as in the case of Global Change, has great learning value in that it is a learner-driven activity, which requires some degree of "understanding". It also engages the students and support the creation of (a learner-driven) electronic dialogue. However, the collaborative activity could be enhanced by asking students to formulate

questions that will bridge the classtime discussion on the face-to-face meeting in the Global Change course to the follow-on electronic dialog on the same topic.

d) Portfolios

In the Danish course the idea of a personal space to provide "home" and overview was provided through an individual homepage, which the student could elaborate on themselves, as their skills throughout the course developed. However, the space for the personal dialogue with the teacher was not explored. Being rooted deeply in the pedagogical idea of collaboration, only collaborative dialogue was encouraged. The learning process in a virtual world can for some students be lonely and devoid of personal interaction. However, the evaluation of the electronic portfolios in the Global change course indicated that a personal portfolio seem to offer a personal space to which the student can retreat for some security and control throughout the learning process. From the teacher's perspective the electronic portfolio gives a good overview from which to "manage" interactions and individual student status (to whom did I write what, where, and why?). When existing and acting in the virtual world, we often cannot directly use the knowledge of relation and navigation we are (bodily) familiar with from the real worlds (Lakoff & Johnson, 1980; Sorensen, 1991). This causes us to feel less in control. This again produces insecurity, which is not promoting motivation to stay put and learn. A personal "office" where the student feels pretty much in control (also with respect to the ability to "furnish", etc.) could potentially be a tool, through which he/she can nourish his/her identity. In sum, merging the American use of electronic portfolios and the Danish idea of "personal-furnishing" seems the optimum choice.

5.2 Quantity and quality in design of asynchronous distributed CSCL

a) Quantity as a means of stimulating interaction

The problem of stimulating interaction in online learning is very frequently experienced and a problem reported of in the literature concerning distributed CSCL. Much research generally sees this as a problem related to course design and facilitation (Feenberg, 1989; Fjuk, 1998b; Sorensen, 1999). A certain apprehension have been formed by the position that - in a free and truly student-owned dialogue - one cannot "force" student comments, the thinking being that "force" was not a true learner-driven motivation for engaging into a dialogue. The problem of creating interaction remains a very complex problem, especially from a constructivist and collaborative theoretical position, in which interaction is viewed to be a central key to learning. The problem of getting students to talk is a recurring problem, treated as "lurking" (Feenberg, 1989) in the literature. We know that it may be rooted in socio-psychological issues, such as the fear of having a comment electronically stored for everyone to return to viewed by others as stupid, or perhaps inhibition with respect to expressing oneself in writing.

Requiring certain amounts of comments from students was not part of the Danish course, but it was part of the American. The collaboration and evaluation done by the Danish students has caused the Danish side to acknowledged that "forcing comments" may not be of much value in itself, but nevertheless a very functional means to ensuring two types

of learning processes to occur. First, the student's formulation in writing of his/her thoughts, as writing is in some ways thinking made tangible. Second, it stimulates interaction and communicates the idea of "presence" and "shared space", a feeling conducive to learning. It is clear that the lack of shared physical implantation in **time** and **space** (the parameters usually providing consensus around communicative structure and status) is lacking in the online environment (Sorensen, 1999). Put in different terms, the symbolic character of the shared virtual environment (where the only sign of presence is "a comment") causes a need for distributed learners to have part of their communicative actions functioning as expressions of "presence". Correspondingly, the "presence" of others is a high motivating factor for expressing your thoughts (only few people engage into a verbal dialogue when they are all by themselves). "Silence" in electronic dialogues communicate "there is nobody here" (Feenberg, 1989).

In sum, requiring numerous comments as a means of ensuring the development of a dynamic interactive dialogue should be viewed as a fruitful approach.

b) Use of quality and quantity for evaluation

Also the challenge of evaluation of online learning is a recognized problem in distributed CSCL research. A challenging issue explored on the Global Change course has been the use of quantity and quality for evaluating/marking student performance in relation to the electronic dialogue.

Quantity is, of course, easy to measure. Evaluating quality consists of looking for evidence of: independent concept analysis reflective thinking, going beyond material presented in the learning units, reporting a real-world observation that exemplifies a concept, or carrying out a calculation relating to a class item (e.g. one student calculated how much global sea level rose as a result of a break-off of a large chunk of ice from Antarctica). Examples of low quality include requesting factual information without stating a conceptual basis for needing such, stating an opinion with no logical basis, straying from the discussion topic without logical reason to do so, and lack of precision and brevity in discussion.

The metaphor of a committee meeting (a kind of experience that most students will face in employment situations) is used for the discussion. The metaphor implies processes like "bringing information" or "bringing some skill" that a committee needs to complete its task. The metaphor also denotes that participation by everyone is desirable (at least 5 electronic comments are required for full credit). The committee functions well when each member responds, when appropriate, to another committee member (each student must respond to at least 2 other students). The committee also functions well when each participant offers relevant information that contributes to the task; good information usually elicits response from others and irrelevant information usually leads to a change of topic (must elicit responses from 2 other students). Committee participants should come to the meeting prepared, meaning they should not ask questions for which information was provided in advance unless it was unclear (discussion should not ask for a repeat of class material, but should include requests for clarification or implications) (must be high quality comments).

Using this evaluation model, the following discussion characteristics are rewarded as being high quality because they help the committee move toward achieving its task: questions requesting clarification of ambiguous points, new and relevant authoritative information, opinions substantiated with logical arguments from accepted facts, synthesis of given information, hypotheses whose testing would lead to new insight, or a calculation that reveals new insights (e.g., the sea level rise calculation). On the other hand, the following characteristics do not lead to a productive committee process but may contribute to a loss of credibility to the author: sweeping generalizations, impractical solutions, unsubstantiated claims, questions raised that are broad and reverse progress of the discussion, and degrading or impolite comments.

The Instructor's Portfolio allows the instructor to concatenate each student's discussion (list all discussion of a single student in a single document). This allows scanning of responses over all topics for a single student to look for patterns of characteristics listed above. The instructor is helped somewhat by a form of peer evaluation in that interesting topics usually generate many comments, and irrelevant dialog often goes unanswered.

5.3 Structure and meta-communication in design of asynchronous distributed CSCL

Much research shows evidence of an enlarged need for structure and structuring at all levels in online learning processes. The Global Change course has indicated that employment of structure should be concerned, not only with the overall elements of form/process (the structure of the overall learning design) and with communication (a consistent structuring of the electronic fora). It should also be employed in the detailed structuring, contextualizing, and meta-communication of each little building stone of content in building the learning process. Global Change (e.g. the learning overview unit 1-1 with the NASA-picture) was judged by the Danish students as an excellent example, demonstrating such a careful and thorough content-process building). Although first and second generation distance learning materials have demonstrated a clear focus on structuring content, this seem in many cases of third generation distance education to be a forgotten part of the past. The move to third generation was a very radical move to a qualitatively new organization or paradigm for distance education (Nipper, 1989; Sorensen 1997), which totally left the focus on content behind. Usually, reflections on "content" of a course based on the Internet have mostly been concerned with trying to employ the potential of "new multimedial ways to communicate the content". In other words, a perspective aiming at enhancing - through the use of pictures, graphics, sound, etc. - the quality of the material by employing other "senses" of the learners, having different preferences in relation to learning styles and perception.

5.4 The use of video conferencing in design of asynchronous distributed CSCL

In the Danish course the use of videoconferencing was implemented in the design as a way of getting practical experienced with a part (a technique) treated theoretically as part of the content. Therefore, reflection on own experience in relation to both form and event was part of their challenge. Overall the videoconference (1.5 hours) was perceived as a good experience and considered a valuable tool for distributed collaborative learning situations, in which synchrony in time usually is an exception. There were comments

which suggested that the "scene" on the Danish side could be improved, that it was too much like watching TV because of the setting. However, the very interactive way the session was composed on the American side in small thematic units was perfect and allowed for a very interactive experience, so much so that it at times totally eliminated the feeling of TV-watching. A way of perhaps improving the setting could be to on the Danish side to have teams of 4 students each, clustered around individual small tables and each team having responsibility for a particular theme. This would emulate news analysis TV programs where a team of 4 news analysts or subject experts dialog with the remote person. However, this makes more work for the camera person, with moving from one table to another. As mentioned earlier, the recording of the videoconference was implemented on the web in the virtual environment of the Danish course, so that the remote students that we not able to participate, could access the resource from home.

In sum, the videoconference worked as a very creative and interactive tool. There are however some important key points that are likely to be important for a good learning experience: prior preparation through dialog in portfolio between the parties of the videoconference (promotes acquaintance and security to talk) and composing the session in small interactive units (that allow for mutual dialogue).

6. Conclusions and future perspectives

This paper has described the outcome of a process of "mutual learning" achieved through a diversity established across national borders. By use of a cross-disciplinary and cross-cultural collaboration between two web-based courses, we have explored issues like pedagogical approaches to collaborative learning and evaluation of learning in asynchronous, distributed virtual environments on the web. A variety of online pedagogical problems and techniques have been treated and considered, and two important tools for collaboration in distributed CSCL have been evaluated. A next phase of our cross-cultural and cross-disciplinary collaboration will be to build on this initial experiment to explore ways of infusing project elements indigenous to the Danish system into the Global Change course and to deploy some web-based functionality developed in the Global Change course into the Danish sequence of courses.

Acknowledgments

Contributors to the design and implementation of the Global Change course include Doug Fils, Michael Taber, Jennifer Hodson, and David Flory. The course is implemented under the auspices of the International Institute of Theoretical and Applied Physics. Contributor to the design and implementation of the Danish course includes Thue Ørberg at the Institute of Communication, Aalborg University, and the Danish students participating in the evaluation of the Global Change course.

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