Supporting Project-Based Collaborative Learning Via a World Wide Web Environment

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Project-Based Learning: Its Potential and Its Problems

Project-based tele-learning is defined as problem-oriented learning within the framework of a group project and using telematics support for the project activities. Collaborative learning in a problem-based context emphasizes inter- and intragroup interactions, where the students actively participate in the learning process while solving a problem as a group. Project-based instruction (see, for example, Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991) is a didactic strategy where not only problem-specific learning goals are involved, but also cognitive and social goals. Van Woerden (1991), for example, notes that project-based instruction in higher education involves a problem as a starting point, with the need to select and apply subject-specific knowledge for the solution of the problem; the contextualization of the project situation as preparation for further professional practice; the need for optimization of group-interaction skills; and the development of responsibility for one's own learning process. Kleijer, Kuiper, De Wit, and Wouters-Koster (1981) see four major characteristics of project-based instruction: self-responsibility for thinking and learning, awareness of social responsibility, thinking and acting from a scientific perspective but in a practical application, and relating both group process and product with professional practice.

Although agreement exists on the potential value of project-based learning, the success of the method depends on many variables whose handling is challenging to all those involved. Applications of communication and information technologies are being designed to support the need of project-based instruction and improve the efficiency of this instructional form in practice. Ryan and Koschmann (1994), for example, describe a variety of hardware and software tools including hypertext/hypermedia facilities, groupware and database facilities, LAN technologies and Internet links resulting in an electronically supported conversation facility, a teaching-case library, and a "clinical encounter simulation stack" to support project-based instruction in medical education. McManus and Aiken (1995) describe the integration of an intelligent tutor as a software coach to support the Jigsaw Methodology (a long-established didactical methodology for project-based instruction; see Aronson, Blaney, Stephan, Sikes, & Snapp, 1978) for groups of students in computer science. Szyperski and Ventre (1993) approach the support problem more generically, by defining and characterizing a class of applications for multi-party interactive multimedia and the network architecture needed to provide
these applications, that can be employed in the support of project work. In their functional characterization of these applications, they emphasize the need for (a) a model of interaction, (b) a dataflow characterization, (c) an accessibility enforcement, and (d) event scheduling.

Despite many such research initiatives, however, project-based instruction remains a challenge for the instructor and the students. Particularly in a learning environment supported by telematic support so that students can work separately from each other in both time and place, the effectiveness of project-based tele-learning may get disturbed by loss of efficiency due to the number of telematic-based facilities that are difficult to control. Challenges are, in particular, with respect to (a) efficient support of communication, (b) efficient and effective access to appropriate (multi-media) information, and (c) efficient management of group processes and of the group’s “memory” (Collis, Andernach, & van Diepen, 1996). The latter describe on-going work in the integration of shared workspace functionalities, e-mail and threaded computer conferencing functionalities, hyperlinked access to file-archives of course materials, and workflow-management tools within World Wide Web sites in different courses at the University of Twente. One of these courses can serve as a particular example of how World Wide Web functionalities can be combined in support of group-based project work.

“Online Learning”: An Example of a Web-Based Course Emphasizing Collaborative Project Activity

The course “Online Learning” (to be renamed “Tele-Learning” in 1997) is an elective course for senior students in the Faculty of Educational Science and Technology at the University of Twente in The Netherlands. Students electing the course are specializing in the design and development of electronic media for learning support. In the 1996 version of the course, there were 33 students, from eight countries. English was used as the common language for the course, although only the instructor is a native-English speaker. The course is scheduled to meet face-to-face for eight two-hour sessions during the Spring term (March-May) and involves approximately 120 hours of time commitment from the students. The students come from a number of different programs with many different external commitments, and some attend the course entirely from a distance, via the Internet.

Relating directly to the objectives of the course is a collaborative learning activity, a round which the project work is based. In 1994, this collaborative activity involved the students in the joint preparation of a course reader, working on teams with distant partners (specialists in other countries, invited by the instructor to join in the collaborative writing activity). In 1995, the collaborative activity was the adaptation of the 1994 reader into an updated version, making as full use as possible of the hyperlinking functionalities of the World Wide Web. In 1996, the collaborative activity was to create a “kiosk” of World Wide Web-based lesson materials for teachers, grouped around 14 different curriculum topics. In all cases, the major conceptual framework of the course was learning design of World Wide Web resources through the actual design and development of World Wide Web resources, in a social-constructivist atmosphere (Jonassen, 1995). From all three years, the students’ final project is available as a World Wide Web site; in each year, the course as a whole has become more and more embedded in a World Wide Web environment itself. The fact that the busy and sometimes off-campus students have little time to meet with each other face-to-face to work collaboratively on their projects is a particular challenge for everyone involved.

These courses and the products of the students’ collaborative project work can be seen at:

http://www.to.utwente.nl/ism/online94/
http://www.to.utwente.nl/ism/online95/campus/campus.html
http://www.to.utwente.nl/ism/online96/campus.htm
Supporting Project-Based Collaborative Learning

The course as seen from the students' perspective is described in Bos, Kikstra, and Morgan (1996) (available through the 1996 site under "Archive"). Other aspects of the course are also described in Collis (1996a, b) and in Collis, Andernach, and Van Diepen (1996).

Evolving the Use of World Wide Web Functionality for Project-Work Support

How can students work collaboratively on a complex project (in this case, involving the joint development of a World Wide Web resource) when it is difficult for them to arrange to meet face-to-face for their project-related tasks? In the 1994 and 1995 versions of the course, heavy use was made of e-mail with file attachments, computer conferencing, and joint access to a designated space (partition) on the server for each project group. The fact that all of these were separate environments, and also were separate from the World Wide Web environment in which the HTML files needed to be accessed, as well as from the HTML-editor environment in which the pages were created, caused a heavy strain on project management, not only for each of the groups, but also for the instructor, who had to conceptually integrate all the various activities of the groups as well as technically link all the pages that were produced into the final project sites. (In the 1996 kiosk, there are more than 800 student-made files involved. After the 1995 experience, the course was re-designed (or "pedagogically re-engineered;" Collis, 1996a), so that both the process of the course as well as the product of the course are all integrated into one World Wide Web site.

![Netscape - [Online and distance learning'96]](http://www.to.utwente.nl/em/online96/campus.htm)

**Figure 1.** Main menu of course site for "Online Learning," 1996.
The 1996 Site: Integrated Support for Learning, Project Work, and Project Presentation

The main menu of the 1996 site is shown in Figure 1 on the previous page. The first of the options was used for message-type comments from the instructor, replaced at least every week (a banner message, run by a Java script, scrolling across the bottom of the home page, informed the students of the date and time when a new message occurred). The archive option took the students to a collection of reference materials for the course such as the course outline (the course is paperless; all materials are available through the World Wide Web site itself). The archive also serves as the entry to one-to-one communication among the class members and to other resources such as the previous versions of the course and the readers produced by the students during those versions. Most important to the project work, however, are the other two options. The Week-by-Week option is shown in Figure 2.

The Week-by-Week matrix serves an important role in integrating the theory and practice of the course. Each week a new interactive reading was inserted into the site, containing a large variety of external links as examples and extensions of the reading material itself. The reading material was also hyper-linked to the project-directions for the week (in the “Follow-Up” cells) and to the feedback given by the instructor to the group as a whole during each week.

Most interesting, however, for the support of project work was our use of a shared-workspace environment. The environment used is a tool produced by (and freely available from) the

![Figure 2. The "Week-by-Week" matrix, integrating course readings, outlines for face-to-face sessions, directions for project activities, and feedback.](image-url)
GMD Institute in Bonn, Germany. The tool is called “BSCW”: Basic Support for Collaborative Work (http://bscw.gwd.de/Introduction/visitor.html).

BSCW supports the storage of various sorts of documents, text and word-processed files, hypertexts, audio, images, and video. It is World Wide Web-based, so using the environment is platform independent. Every group has its own workspace. BSCW keeps track of the events in the workspace, such as adding, reading and updating documents and of the agents involved in those events. Features such as various sorts of visualized file management functions (renaming, locking, “checking out a file,” etc.) are also available. A particularly valuable aspect of BSCW is that group members can add remarks to their files, so that their groupmates can see at a glance what the intention or status of a newly-entered file might be.

In the “Online Learning” course, the students entered their workspaces directly from the main menu, via the “Project” option. After choosing this option and entering a new password, students saw the new menu of the BSCW, with icons for each of the 14 groups (and for the instructor). Choosing one’s own workspace area yields a display such as the one shown in Figure 3.

Figure 3 shows a number of the very helpful functionalities of the shared workspace. Students can easily add any external or internal HTML file to the workspace, and can open and interact with the file, also from the workspace. This is a very helpful property, avoiding the need to move in and out of browser, directory, and communication environments in order to inspect new World Wide Web pages and give comments about them to one’s groupmates. Sim-
ilarly, other types of files can also be opened and examined and commented upon, all from the same environment. (Actual editing of the various files cannot take place in this environment, however; files must be "checked out" to one's desktop, edited, and "checked in" again. These steps are simple, as they are well-supported by the BSCW tools.)

The workspace allows groups to create different workspace areas corresponding to each subdirectory or subfolder that they create. This function was very important for management as the number of files and versions of files increased. It was also very important for the instructor, who could give an instruction (via a “Follow-Up” cell in the “Week-to-Week” matrix) such as "Please put all your current versions of files in a folder 'Week x evaluation' so that I can come in this weekend, see what you are doing, and give you feedback on your current pages"). The message function lets the instructor conveniently add feedback directly to a file for the entire group to read, feedback that the group members can subsequently add to in their asynchronous communication with each other.

Among the other benefits of the shared-workspace environment was that it was integrated directly into the overall course site, with the standard navigation icons for the "Week-to-Week" matrix, to the Archive, and to the actual student product area (the "kiosk") always available, so that movement between all aspects of the overall course environment was integrated and easy. The World Wide Web functionality makes this possible.

For Further Development...

Although the results so far of this integrated World Wide Web course environment have been positive in terms of both student and instructor evaluations, there are many needs and improvements still required. In particular, the timeloss on the instructor remains high and ever higher, with existing World Wide Web systems as with previous network support forms. The ease with which all the group members can communicate with each other and with the instructor is a two-edged sword: excellent for facilitating project work and collaboration but overwhelming for the instructor in terms of time for quality response. Administration and ongoing record keeping of all the group and individual student work is also demanding; in the 1997 version of the site, we are adding some data-collection tools to automate this to a certain degree. Communication support for threaded discussions, such as was available through our previously-used computer-conferencing environment, was not built into the 1996 site, but will be in the 1997 site, via newsgroup functionalities. Better interactivity will be built into the reading material of the course, via the use of cgi-forms and "magic cookie" types of data-passing, so that students can be challenged to give responses to the readings and external links, and the instructor can retain a record of these responses as well as tailor the feedback given to the responses. An authoring environment will be used to structure the weekly reading materials and offer different paths through the materials for students with different roles and interests within the groups (Horst et al., 1996).

But it is the World Wide Web functionality that underlies all these possibilities. As the instructor of the course, and someone who believes strongly in the value of project work as a social-constructive approach to learning, I am excited about the possibilities that the World Wide Web offers. I am also sensitive to the need to look critically at those possibilities in terms of their overall contribution to project-based learning. Finding the indicators that help to focus in on the most profitable combination of tools and pedagogy for World Wide Web-based project learning is also the subject of a new interdisciplinary research project (1996–1999) which we have just launched (Collis & Widya, 1996).
Supporting Project-Based Collaborative Learning

References


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http://www.to.utwente.nl/user/sm/collis/personal.htm