Web-Based Learning and Teaching Technologies: Opportunities and Challenges

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Chapter IV

Selecting Software and Services for Web-Based Teaching and Learning

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As the World Wide Web has developed to be a widespread and reliable communication medium, a wide range of software and services has emerged to support teaching, learning, and collaborative work. These new software and services provide opportunities for supporting and enhancing teaching and learning strategies and practices. There are already many different types of software and services with many providers in each broad category; yet, given the rapid rate of change of the WWW, the specific nature of the software and services, the providers, and perhaps even the categories themselves, will change over time. One issue that teachers face in this new and rapidly changing environment is the choice of software and services to support their teaching and learning activities.

Our goal in this chapter is to develop a model and guide for teachers who want to select software and services that support or enhance learning, and in particular collaborative learning, through the World Wide Web. We are concerned here, not with products and services that require significant investment in time, money, or technical resources, but with simple and low cost software and services that might be used in practice by teachers to support ‘every day’ teaching and learning, whether at school or on campus or by distance learning.

This chapter introduces a general model for analysis and selection of software and services for Web-based teaching and learning. Some currently available software and services are then reviewed within a classification scheme based on a key dimension of the model: teaching and learning activity. The dimensions of the model form a guide for description of the characteristics of the software and services. The model is then used as the structure for a case study that illustrates how the dimensions of the model can be used by
teachers to select software and services for Web-based teaching and learning. The chapter concludes with a guide to selecting software and services.

**ANALYSING SOFTWARE AND SERVICES FOR WEB-BASED TEACHING AND LEARNING**

Use of Web-based software and services for teaching and learning offers several advantages over use of software that requires proprietary client and server software. For students, learning activities that can be accessed through a WWW browser attract no additional software costs and may not attract Internet access costs if the educational provider covers these costs as part of normal course provision. For the education provider, use of the WWW for teaching and learning often incurs little or no additional infrastructure costs beyond extension of Internet service to the teachers and learners participating in Web-based activities. The availability of services provided and maintained on servers outside the educational institution means that it is possible to offer Web-based teaching and learning without local administration of a server and, therefore, with minimal local technical support. (In this chapter, when we say “services”, we mean the software offered by providers who maintain the software on remote servers, alleviating the need for local software management.)

Although these advantages are achievable, many factors intervene as a teacher attempts to identify the most appropriate, affordable, and accessible software and services for use in his or her own teaching and learning. The authors have studied the question, “How can a teacher select appropriate Web-based software and services to enhance or support teaching and learning?” through several case studies of Web-based teaching and learning in different organizations. Four key dimensions to which teachers should pay attention as they select software and services for Web-based teaching and learning have emerged. The dimensions are: an educational dimension, a task dimension, an administration dimension and a technology dimension.

**The Educational Dimension**

The educational dimension encompasses current policies, strategies, practices, and trends in education, and the goals of the educational institution, the ‘style’ of education offered and the number and type of students.

Teachers use a range of strategies to encourage learning. These strategies include lectures or presentations, workshops and laboratories, seminars or tutorials, self-guided instruction, consultation, and collaborative learning activities. Few teachers use one strategy in isolation from the others; rather, they combine strategies. Several examples can be drawn from university education: most on-campus undergraduate courses use a combination of lectures and workshops or tutorials; many distance education courses use an open learning model which combines self-guided instruction with collaborative learning activities and almost all courses provide the opportunity for students to consult their teachers one-to-one. Collaborative learning is the strategy currently attracting most attention in many countries and at many levels of education (Collis and Smith, 1997; Smith and MacGregor, 1992).

Institutions vary widely, and decisions about educational technology should be expected to vary just as widely. A technology solution that works in a college with a large
undergraduate population that is used to an educational strategy based primarily on on-campus lectures will not work in a postgraduate business school where learning occurs in seminars and through small group projects. Institutions that include a diverse range of schools which use different teaching and learning strategies to reach different populations of students should expect to adopt an equally diverse range of Web-based teaching and learning solutions, unless there is a good educational reason for changing the fundamental teaching and learning strategies of some of those schools.

**The Task Dimension**

The task dimension focuses on the educational goals of the Web-based teaching and learning initiative, the specific task or tasks through which learning is expected to occur, the participants, the nature of the activities adopted to complete the task and to achieve the goals, the time and place in which the tasks are to be completed, and the richness of the communication required to successfully complete the task and achieve the goals.

The educational goals and specific tasks to be accomplished with a Web-based teaching and learning initiative vary widely. The goal of a lecture may be to deliver material to enhance students’ knowledge of a particular topic. The goal of a workshop may be to develop students’ skills in a particular technique, and the tasks are likely to involve practice in that technique. Seminars and tutorials often aim to improve or to deepen student understanding of aspects of a particular topic, or to develop certain attitudes among students, and student tasks may include reading, analysis and presentation of their views to fellow students and the teacher. Educational collaborations are directed either toward building of communities or helping people get to know one another and about different communities or cultures, or toward achievement of specific tasks in projects completed by learners in collaborative teams. For example, in the global virtual team (GVT) project organised annually by the University of Texas, students from many universities across several continents form virtual teams to produce joint business plans (Knoll and Jarvenpaa, 1995). During team formation they act as a virtual community, learning about one another and becoming a cohesive, well-socialized group. As they produce business plans, they are engaged in a collaborative project with goals and deadlines and performance criteria.

Achievement of all of these goals and completion of most student tasks requires effective communication among participants in the teaching and learning process. Regardless of educational strategy, teachers need to communicate effectively to students. In seminars and tutorials, and in collaborative learning, students need to communicate effectively with one another. Three main types of activity are frequently observed in educational tasks: communication, collaboration and coordination. Through **communication**, teachers and students exchange information, ideas, and thoughts, and express their feelings, as they discuss and learn about topics and tasks or about other people and cultures. Communication may be fundamentally one-way as in a lecture when the teacher delivers material to students, or multi-directional as it must be if students are to learn from one another through collaborative learning. Through **collaboration**, people work together to complete common tasks or to meet shared goals. **Coordination** is the process of setting and monitoring activities toward completion of a task on time and with the available resources. Effective communication underlies both collaboration and coordination.

Various educational technologies allow communication among students and teachers working at the same time (synchronously) or at different times (asynchronously) and in the same place (e.g., a classroom) or a different place (on-campus or off-campus, in the same
Asynchronous communication has the advantage that participants have time to prepare material and deliver it after rehearsal and correction, and in some cases, withdraw it before others have read it. It does, however, lack the immediate feedback provided by synchronous communication.

The *richness* of a communication medium refers to the extent to which the medium conveys the intonation of voice and expression of physical gesture that accompany face-to-face communication (Daft and Lengel, 1990). A rich communication medium conveys the *presence* of participants in the communication strongly. In this sense, the richest communication naturally occurs when people meet face-to-face: intonation can be heard, gesture can be seen, and conversation offers immediacy of response because communication is synchronous. Video provides the opportunity for the richest computer-mediated communication because, when used well, it enables each participant to see the gestures of the others and to hear the intonation in their voices.

The nature of the goal, task, and participants and activities involved in completion will dictate the time, place, and richness of the communication required. At one extreme is a lecture or presentation which requires no feedback from students; such a presentation need not be delivered in the same time or same location as the student audience, but prerecorded and delivered through a range of media, including broadcast, CD-ROM, or as a video file downloadable on demand from the WWW. Complex coordination tasks, on the other hand, tend to require the rich communication of a face-to-face meeting or access to tools that reproduce such richness well.

**The Administration Dimension**

The administration dimension takes into account existing resources and constraints on adoption of Web-based software and services. Important factors are the available funding, technology and human resources. The technical skills of the instructor and students, and their time and interest in learning to develop a new learning environment strongly influences the selection of software and services. While Web-based services are maintained by the staff of the host organization, some local user administration (e.g., creation of user accounts) may be required. Access to learning support staff is often a critical factor. While simple Web-based environments can be established by instructors with little time or effort, learning support staff can significantly reduce the effort required by instructors new to these environments. Development of collaborative learning environments requires little technical knowledge or skill, while development of environments for publication and distribution of resources requires expertise and time beyond that normally available to an instructor.

Several technology issues are also important as enablers for or constraints on Web-based teaching and learning, particularly the available hardware, operating system and messaging protocols, available network bandwidth, security policies and practices, system response time, the availability and skill of technical support (as distinct from learning support staff) and the extent to which any software acquired can be customized or extended for the local environment.

**The Technology Dimension**

Appropriate software and services selected for Web-based teaching and learning in a given context will reflect decisions about educational strategy, goal, task, activities, time, place and richness of interaction. It will be selected within the prevailing resource
constraints. The technology dimension matches educational goals with available technologies. Some categories of technology for Web-based teaching and learning are clearly appropriate only for certain educational strategies. Table 1 shows generic categories of Web-based software that support the educational strategies introduced earlier.

Table 1 shows that there are WWW technologies to support all educational strategies. Lectures, presentations, activities, reading, references, case studies, and other material prepared using non-Web technologies can be incorporated in Web-based teaching and learning through distribution on the WWW. The WWW plays a unique role, however, as a communication and collaboration medium. For the remainder of this chapter, we will concentrate on selection of software and services that draw on this unique advantage.

**SOFTWARE AND SERVICES FOR WEB-BASED COMMUNICATION AND COLLABORATION**

This section presents examples of software and services available for Web-based communication and collaboration. They are introduced by the educational activity that they most support: communication, collaboration, or coordination, and discussed in terms of relevant attributes of the dimensions introduced above.
Web-Based Software and Services for Communication

Communication tools fall into different families as listed in Table 2. Each family reflects both the timing and the richness of the communication, supports different types of task and offers different advantages for use in Web-based teaching and learning.

**Electronic Mail**

Electronic mail is the most used asynchronous communication medium. It has long been possible to attach objects of any kind (from documents to multimedia enriched files) to e-mail. Recent enhancements make it possible to enrich the message itself by inserting HTML code in the body of the mail. It is possible to add different styles and colours to the text, to embed images or to reproduce full HTML pages.

Many free e-mail services are available on the WWW (see list maintained by Yahoo.com). These services are maintained by the service providers on their own servers. While the functions of these services are not (yet) as sophisticated as those of the e-mail packages or clients on a user’s computer, they offer a satisfactory solution for many educational situations where facilities for local management of accounts and mail is difficult.

**Distribution Lists**

Distribution lists are systems where e-mail messages are sent to a centralised server, and from there distributed to a list of addresses. Use is as simple as sending e-mail. Well known are Listserv (with an educational free version) and Majordomo. Archives of messages can be accessed through the WWW and users may subscribe from a Web page or by sending e-mail to a server.
WWW-based distribution list services are emerging: for example, **ONElist** offers Web-based creation and maintenance of distribution lists with a range of options (public or private, moderated or unmoderated, etc) and the list’s archive is searchable. It is therefore now possible to use a free Web-based service to establish and maintain distribution lists, without the need to maintain a local server or software mounted locally. There is a trend toward integration of discussion lists with larger, integrated Web-based communication services and community building software. **eGroups**, for example, enables creation of “communities,” with a home page, file space and more.

**Conferencing Systems (Forums, Discussion Databases)**

Conferencing systems (also known as forums or discussion databases) organize messages in a “tree” structure. Messages are grouped in “threads” which allow participants to follow the sequence of messages exchanged in several discussions held in parallel. Sophisticated conferencing systems developed outside the WWW, and proprietary systems, still provide the most functionality through specialized servers. Many proprietary systems (e.g., **Domino/ Lotus Notes, FirstClass**) do, however, now provide access through Web browsers. Conferencing systems form the basis of the emerging category of specialised Web-based collaboration software discussed later in this chapter.

**Chat**

Chat is text-based synchronous communication. Some richness is provided by the immediacy of communication where another person’s words appear on the screen line-by-line or character-by-character (increasing the feeling of presence). Chat systems are often structured in “rooms” with public or private conferences, but some systems (e.g., **ICQ** and **PowWow**) allow direct point-to-point chat between two or more participants.

Many Web sites offer a free chat service for their customers. Some community building services also provide a list of community members who are currently online and available for chat.

A number of features can enrich text transmitted through chat. **PowWow** and **ICQ** can transmit “emotional” sounds (laughter, sighs, etc.). Some chat systems (e.g., **Microsoft V-Chat**) are being enhanced through representation of the participant as a graphical **avatar** which can move and interact with gestures or other actions in a virtual space.

**Audio and Video Tools**

Asynchronous audio and video have a long history as educational media for presentations and for interactive activities. One of the most significant advances in one-way presentation of material from the WWW has been the family of streaming technology and related software (e.g., **RealAudio** and **RealVideo**) that not only enables educators to record interesting material with surprisingly little effort but also allows broadcast of audio and video via the WWW. Client software to play material is usually distributed for free.

A growing Internet telephony market, free software (such as **Microsoft’s NetMeeting**) and the adoption of standards have now made synchronous desktop audio video communications both accessible and affordable: several products allow direct connection between two users’ (client) computers while other solutions allow more computers to participate in live conferences through servers.

Effective use of audio and video tools requires appropriate hardware and sufficient communications bandwidth. Most modern PCs come adequately configured, but a digital
video camera is also required for video communication. Modem connections through standard telephone lines, although not high quality, are sufficient for many educational purposes. Telephone connection quality does vary from time to time and in different locations, and until such low bandwidth communications become more reliable, a backup should also be available. The authors often work with Vocaltec’s InternetPhone open for audio and video alongside ICQ for text-based chat to provide redundancy and backup. When bandwidth is low, we prefer to turn off the audio and type messages in a chat window while leaving the video window open to see, through facial and other gestures, the recipient’s response. Alternatively, it is possible to use software such as PowWow for audio communication only or audio supplemented by text at a very low cost on low bandwidth lines.

**Integrated Tools**

A growing family of tools provides integration of synchronous communication tools with other services that improve accessibility to and functionality of synchronous communication. Most of these tools maintain a list of Internet users with whom the user would like to keep in contact (such as members of a collaborative learning group) and provide information about whether or not users on the list are currently connected to the Internet and free to communicate. Some, such as ICQ and PowWow, will determine the IP address from which a user on the list is currently connected and start a live audio-video conferencing session. On-line file transfer between user computers, and “Web-cruising” (“driving” another user’s Web browser) may also be provided. While the best known integrated tools require specialized client software, other forms of integration are provided by the Web-based collaboration services described in the next section.

**Table 3. Web-Based Collaboration Tools**

<table>
<thead>
<tr>
<th>Family of collaboration tools</th>
<th>Communication tools and collaboration features</th>
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<tbody>
<tr>
<td>Community building</td>
<td>home page for community</td>
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<tr>
<td></td>
<td>links page for community</td>
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<tr>
<td></td>
<td>home page for individual user</td>
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<tr>
<td></td>
<td>links page for individual user</td>
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<tr>
<td></td>
<td>community e-mail distribution list</td>
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<td></td>
<td>who is online</td>
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<td></td>
<td>public and private chat (text)</td>
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<tr>
<td></td>
<td>newsletter production and distribution</td>
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<tr>
<td></td>
<td>individual, sharable calendars</td>
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<tr>
<td>Computer-supported collaborative work (CSCW)</td>
<td>workspace for work group or group of learners</td>
</tr>
<tr>
<td></td>
<td>ability to populate workspace with documents and other objects, including URLs</td>
</tr>
<tr>
<td></td>
<td>integration with user’s existing e-mail service for individual and group distribution of e-mail</td>
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<tr>
<td>Learning environments</td>
<td>templates for course materials</td>
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<tr>
<td></td>
<td>tools for development of course materials</td>
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<tr>
<td></td>
<td>integration of course administration with course content</td>
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<tr>
<td></td>
<td>course material repositories</td>
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<td></td>
<td>integrated discussion or conferencing areas</td>
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Web-Based Software and Services for Collaboration

All of the communication tools described above can be used to support collaboration, but there are also tools designed specifically to support collaborative work. These tools offer a range of integrated functions and come in two main categories, reflecting the two main goals of collaborative work and collaborative learning: community building and computer-supported project work. In addition, there are several learning environments that combine course administration with communication and collaboration. Table 3 summarizes the features of these families of tools; they will be discussed in more detail in this section.

Software and Services for Community Building

Several Web-based services have been designed specifically to support building of communities of people with shared interests. Community building tools combine asynchronous and synchronous communication tools with Web pages and other services to support “virtual communities”. A variety of forms of communication can be selected and used by members of a community to get to know one another and to discuss or share ideas of mutual interest. The services are accessed from a standard Web browser. Communities can be run with no local administration other than invitation of new members. Although free communities are maintained by the service provider, most have space limitations which can be overcome by paying a fee.

Several services that are simple to set up and maintain for educational purposes are available free of charge (e.g., webb.net, Delphi Forums). Webb.net, for example, offers a range of services designed to integrate personal communications with content of specific interest or relevance to each community, member, or user. Webb.net offers facilities to create a personal Web site and facilities to join or to create a public or private virtual community. Personal profiles are maintained on the server so returning users, after login, see a personalized starting point. It is easy for a teacher to set up a private community for a class or for a group of students engaged in collaborative learning. Subsequent administration of the community can be done by the creator or another person with the privileges nominated by the creator.

Software and Services for Project Work

Software designed to support collaborative work is particularly useful for collaborative learning projects because it provides facilities for information sharing, document sharing and compilation of shared work. Software in this category includes Web-based software such as BSCW (Basic Support for Cooperative Work), Web-enabled proprietary software (e.g., Lotus Domino/Notes; E-Res) and proprietary systems available for short-term rental through Internet Service Providers (e.g., Lotus Instant! TeamRoom and Lotus QuickPlace).

BSCW illustrates the range of software and services available in this category. BSCW allows registered users to share documents and other objects contained in a workspace shared by members of a group. The workspace is accessed from a standard Web browser. Unlike community building services which come ready-configured with a user interface, BSCW provides an empty workspace and a rich range of functions that may be used to populate the space with references, objects, and threaded discussions related to the project. The owner of a space defines the structure, creating folders within the workspace and assigning access rights; for example, it is possible to set up a folder dedicated to a course that is shared by a group of teachers, and inside it, a sub-folder for each group of students.
in a class. There is no limit to the type of file that can be posted as an object, and files can be downloaded or launched (depending on the configuration of the browser) on the user PC with a single click. Clickable links to URLs can be posted as objects. BSCW is integrated with the user’s normal e-mail, so users with their own e-mail services need only check and maintain one system. Users can send e-mail using their own client from within BSCW, and receive e-mail alerts to activities within the workspace.

BSCW is available free to educational users either as software that may be mounted on a local server or as a service through a public server located at the National Center for Information Technology in Germany which developed the software. It is a valuable tool for collaborative learning, as several case studies have shown (Bielli, Kumar, Renzi and Klobas, 1999; Macaulay, Shaikh and Young, 1998).

Overall, this category offers sophisticated management of shared objects, of a kind that is often necessary in collaborative project work. Increasingly, they integrate collaboration services with communication services such as e-mail and chat.

Software and Services for Course Administration, Communication, and Collaboration

Several learning environments combine course administration with communication and collaboration. These environments, sometimes known as Web-based classrooms (McCormack & Jones, 1998) act as containers or high level templates within which many of the functions of running a Web-supported course can be collected. They offer solutions for teachers who are seeking software that provides integrated access to all course activities from a single interface. They are particularly valuable for distance courses, but also for large-scale Web-based teaching and learning initiatives mounted as a cooperative effort by an institution, school, or moderately large teaching group.

Although Web-based classroom environments have different origins (conferencing systems, workgroup software, Web publishing software, multimedia software), they are converging to supply a set of integrated environments that make the classroom and student administration accessible from the Web. They all provide facilities for mounting lessons on the WWW, a repository for educational materials and links to Web-based materials, threaded conferencing or discussion spaces, some computer-based assessment capabilities, and some student administration facilities. The best known software in this category includes Lotus Learning-Space, developed from Lotus Notes/Domino groupware systems, WebCT, TopClass and Blackboard.com, which provide sets of tools to build Web-based learning environments.

While the software and services described earlier in this chapter can be used to Web-enable selected components of a course at very low direct cost, selection of one of these integrated environments implies additional costs (and, potentially, economies of scale) related to the purchase, local administration and maintenance, and preparation of a fully integrated administration and course content environment. The communication and collaboration facilities available within the environments are seldom as sophisticated as the purpose-designed software discussed earlier, but the value of a common interface to all Web-based courses and student services may outweigh other considerations.

Web-Based Software and Services for Co-Ordination

Coordination of collaborative work projects can be supported by specialist tools to
manage task and time allocations. The only well-developed family of Web-enabled tools in this category at the time of writing provides access to calendars which can be shared and accessed through Web browsers.

*Calendars Net* is a free service supplying interactive Web calendars. Calendars may be public or private. Calendars can be searched, and online and e-mail alerts can be set-up to notify users of impending events. Useful services for international and cross-cultural projects include the ability to insert the holidays for a country or religious group and the ability to merge the calendars of collaborating individuals or groups.

**SELECTING SOFTWARE AND SERVICES FOR WEB-BASED TEACHING AND LEARNING**

The first section of this chapter introduced several dimensions which we have observed from case studies at the institutional, school, course, and task level, in educational institutions on three continents. Now that we have also surveyed the main categories of software and service available for Web-based teaching and learning, we can develop a guide for selecting software and services for Web-based teaching and learning. The guide indicates the range of information and conditions to be taken into account when selecting software and services for Web-based teaching and learning. It is not a step-by-step process, nor should it take a considerable amount of research, except when getting to know individual technologies and service providers well enough to select one or another for a particular project. We recommend a two stage process where the first stage is a situation review and the task and technology design is completed during the second stage.

**Stage 1: Situation Review**

During the situation review, reflect on or gather information about the two dimensions which establish the environment and set the constraints for task design and selection of software and services for Web-based teaching and learning: the educational and the administrative dimensions. The educational environment, institutional goals, educational ‘style’, and students, and the goals of the course within which the Web-based teaching and learning will be utilised should be defined. In addition, consider administrative issues such as the available financial, time, and human resources, both among teachers and technical staff; the amount of training and skill required of technical staff, teachers, and students; the available technology, including hardware, operating systems, Internet access, network bandwidth, and server response time; and existing institutional policies and practices concerning use of Web-based software and services.

**Stage 2: Task and Technology Design**

This stage is called “task and technology design” because design of educational tasks to meet the goals in the situation identified in Stage 1 will be informed, and to some extent, constrained by the available software and services and their characteristics. Task and technology design cannot be described as a simple sequence of steps. During this stage, attention will be paid primarily to the task and technology dimensions, but not without reference to the constraints imposed by the administrative dimension. A teacher may have some ideas about a suitable task, but will need to confirm that suitable and affordable software and services are available to achieve it; some trade-offs between task and technology will be required as the teacher refines the task so that students will be able to meet
the teaching and learning goals with the available technology. Alternatively, a teacher may have an idea that a certain technology (e.g., computer-supported cooperative work software) will enhance learning, but will need to design an exercise that will use the technology effectively to meet educational goals. It is important during this stage to set tasks that meet educational goals rather than to invent tasks to test the technology. Students are motivated to participate in exercises when they can see that they will learn, but not when the educational value of an exercise is outweighed by a focus on technology.

Important factors to consider in this stage include, on the task dimension: the educational goals of the Web-based exercise or task, the participants, the specific task and the nature of activities needed to complete the task effectively; and the time, place, and richness of the communication required to complete the task and achieve the goals. Important factors on the technology dimension include selection of appropriate software and services to complete the task and achieve the goals in the environment and within the constraints identified in the situation review.

**ILLUSTRATIVE CASE**

During the second half of 1998, 120 third year business students at Bocconi University in Milan, Italy, took a course in computing and statistics (Elaborazione Automatica dei Dati per le Decisioni Economiche e Finanziarie, “ELAUT”). One of the course coordinators had been involved in a project in which BSCW software had been used to support an international student collaboration. The students had reported that they had learned a great deal about computer-supported cooperative work (CSCW) through the collaborative learning project (Bielli, et al., 1999). He was convinced by this experience that software for CSCW would also enhance learning among students completing the same on-campus course.

**Stage 1: Situation Review**

The course was developed within an environment in which the coordinator was supported in his efforts to introduce educational innovations into the classroom, but there was no specific university directive or encouragement to do so. The following description of the educational and administrative environment provides further information.

**Educational Dimension**

The predominant model of education in Italian business universities consists of on-campus lectures, supplemented by individual consultation with the professor. There is increasing use of case studies to stimulate class discussion but little group project work. To pass the computing component of the ELAUT course, students need to demonstrate that they are knowledgeable and effective users of Internet technologies. They have to understand each of the generic families of service offered through the Internet (file transfer, e-mail, WWW, etc.), be able to search the Web effectively, and understand the role of the WWW in business and how to select and integrate services.

**Administration Dimension**

No special funds or technical support were available for the project. TopClass and BSCW were mounted on the university’s server and could be made available at no cost to
the teaching staff. In addition, a suite of Microsoft products for Web-development was available to them, but the staff had little time in which to develop new solutions using generic products. The university provided all teaching staff with full Internet access, including e-mail and unrestricted WWW access. Teaching staff also had access to Internet-based desktop videoconferencing facilities through CU-SeeMe, NetMeeting, and VocalTec InternetPhone, and all regularly used ICQ to keep in touch with one another. They were all highly skilled in Internet technology.

About half of the students were novice Internet users at the time they commenced the ELAUT course, but all had had several classes about Internet software and services and had completed exercises in Internet searching by the time the project began. None of the students had used CSCW software before the course. All students had e-mail accounts at the University. About one-third of the students had Internet access from home through local Internet Service Providers.

Stage 2: Task and Technology Design

There were several iterations in task and technology design for the ELAUT course. As the course was first designed, the coordinator simply wanted to introduce group projects that would enable students to learn more about the applications of technologies seen in class. While planning the course, he was evaluating TopClass software as a teaching and learning environment for the course as a whole and writing a report on use of BSCW for collaborative learning in an earlier course (Bielli et al., 1999). Subsequently, an international visiting professor was invited to introduce the students to the concept of computer-supported collaborative work (CSCW). About this time, the coordinator realised that it would be possible to design a collaborative learning project that used BSCW software to support student learning about CSCW. The task and technology informed each other at this point; neither the idea of a collaborative learning project about CSCW nor the use of BSCW was considered separately at any stage. As well as using Web-based software and services for a collaborative learning project, the course team identified ways to continue the visiting professor’s involvement in the course after she had returned home. The detail of the task and technology design follows.

Task Dimension

A collaborative learning project was developed to enhance student understanding of the potential for using the WWW to support collaborative work. Students were invited to participate in a CSCL project through which they would learn more about CSCW and its potential for organizations. The number of participants was limited to 4 groups of 5.

The project centred on a real, rather than a simulated, task, which provided input to an ongoing research program on the economic impact of WWW sites for tourism in Italy. Each group of students was asked to pilot test a proposed hotel site evaluation form by using it to evaluate 20 WWW sites representing hotels in an assigned geographical area of Italy. They were also required to give a group presentation to class, in which they analysed their learning about CSCW. The students had a total of 10 weeks in which to complete the task, with one interim milestone during week 5.

The project involved several phases of work. There was an initiation phase during which the students got to know one another, then an elaboration phase during which they clarified and planned how they would complete the set task. The third phase involved quite
complex coordination because each group was required to produce a single list of hotels in the area from the lists of hotels identified by individual group members, then assign hotels for evaluation to individuals. To complete the project, the individual evaluations had to be provided to the course coordinator by the set date, and a group presentation prepared for class.

Few elements of the project required group members to work together in the same place at the same time. The information gathering, compilation, and evaluation tasks could all be completed by group members working on their own at times convenient to each of them. Group members were not able to meet together on-campus except around weekly project meetings. The visiting professor who introduced the students to CSCW in class would not be in Milan at the time the presentations would be made, but students and staff were keen to involve her in all components of the assessment, including the presentations.

The ability to communicate simultaneously through voice and gesture was particularly important during planning of the complex compilation tasks. Other tasks, such as submission of completed lists to the list coordinator were more routine and seldom required rich interaction.

**Technology Dimension**

In order to achieve the educational goals for this component of the course, it was important to provide students with access to technology that would support completion of a collaborative learning project through communication, collaboration, and coordination. Much work would be done by students working in their own time, so there was no need to meet in the same place, but complex coordination tasks would benefit from synchronous communication. The selected technologies would have to come from the suite of software already available to the teaching staff because no additional funding was available and there was little time for development. Although staff had skills to manage quite complex technical environments, the proportion of new Internet users meant that any technology used would have to be familiar or simple to learn and to use or both. Electronic mail was available and students used this quite often because they were familiar with it, it was fast, and it was compatible with their other communication activities.

BSCW was selected as a CSCW tool that would support communication, collaboration, and some forms of coordination for completion of a collaborative learning project. As a coordination tool, it was most used by the coordinator to call all participants to class meetings. Some students also used BSCW to call meetings, but they preferred to use e-mail which they found simpler than trying to learn a new function in a new piece of software. BSCW was particularly useful as a collaboration tool where students could post the URLs of Web sites and references that they had found, their contributions to shared group documents, and drafts of final reports and presentations. It was not particularly successful as a coordination tool for this project. A calendar tool would have been of some assistance in coordination, but students found the coordination activities so complex that many were completed in face-to-face meetings which provided both immediacy of response and the richness of vocal tone and gesture.

Desktop videoconferencing was used to bring the remote professor into the classroom twice, the first time to demonstrate the use of synchronous communication and collaboration tools and the second time to participate in the presentations. During these sessions, ICQ was used to establish contact, to maintain at least minimal communication through text and to track the connection to ensure contact was maintained through the presentations.
PowWow was used as backup software for this purpose in case the ICQ server became heavily loaded and contact was lost. The remote professor was able to see and hear all presentations through InternetPhone which was used to maintain audio and video connection. A copy of each group’s PowerPoint presentations was uploaded on BSCW just before the final presentation and the professor at the remote location was able to share and browse these documents during the presentations increasing richness and redundancy in the communication (in case of failure of the audio or video). This strategy improved both student and teaching staff’s sense of satisfaction with the project.

Students found the mixture of face-to-face meeting around class times—electronic mail for simple, rapid communication and BSCW for sharing of documents, URLs, and calling of meetings—very valuable. All groups completed the set tasks on time, and all gave presentations that demonstrated deep understanding of the nature of computer-supported collaborative work. All participants were allotted the maximum number of available points toward their examination score.

**CONCLUSIONS**

Several conclusions can be drawn from the material in this chapter. Firstly, despite the apparent complexity of software and services for Web-based teaching and learning, it is possible to work systematically from an understanding of the educational and administrative situation to a task and technology design that meets educational goals within administrative constraints. The model and strategy described in this chapter will help teachers to introduce (or to improve) Web-based teaching and learning by providing a framework for selecting software and services.

Secondly, at least for the moment, no single technology can meet all the goals that may be set for Web-based teaching and learning activities. Each of the tools discussed in this chapter has particular strengths in specific situations and for different types of task. We recommend that you become familiar with, and use, a variety of tools. On the other hand, it is important to balance the number of tools that are used with the resources available and the tasks that are needed to meet educational goals. The choice of tool(s) should be driven by the educational needs, but formed by sound knowledge of the available technologies and their strengths and costs. A good user of Web-based teaching and learning technology will be a good teacher who monitors developments in education as well as developments in information and communication technology and is able to analyse and incorporate developments appropriately in their teaching.

Finally, there are several trends in software and services that will reduce the complexity and increase the availability of Web-based teaching and learning even to teachers who do not have a local technical support structure. In particular, there will be further integration of communication, collaboration, and coordination tools. While it might still be possible to identify different communication functions, these functions will increasingly be combined in integrated services rather than operate as stand-alone services. We may also see an increase in purpose-built environments, such as those currently available for community building, collaborative work and course administration. Furthermore, we expect the trend toward provision of Web-based services to continue. It will increasingly be possible, not just to access Web-based software and services from an unmodified Web browser (or successor interface), but also to manage them. In effect, development, administration and maintenance of
Web-based teaching and learning technologies can be outsourced to external providers.

Some aspects of these changes cannot be foreseen with such clarity. While, at the moment, it is possible to obtain free access to many of the services required for collaborative Web-based teaching and learning, free access may or may not continue, depending on how Internet business models develop. As the market for Web-based teaching and learning services matures, it will become important for teachers to select service providers as carefully as they would select providers of any kind of service that underpins their teaching. An investment in a Web-based environment, whether provided free or not, requires time and effort to get to know the environment and its quirks and capabilities well, so teachers will need to take care to identify service providers who are reliable and who share their philosophy of education.

While the technology market is maturing, educators have an opportunity to learn about the implications of developments in Web-based software and services. For example, while many teachers are now “Web-enabling” their courses by publishing material online, few are addressing the more profound changes in teaching and learning strategies that are enabled by networked collaborative learning software and services of the kind introduced in this chapter. The most effective uses of the WWW require instructors to understand how this new medium changes the ways in which students communicate with one another and with teachers, as well as the ways in which they interact with course materials. Teachers who prefer the technology market to be more mature before adopting new software and services for their courses will benefit from exploring these technologies now. At the least, this is an opportune time for teachers to discover how these technologies can be used to improve communication, collaboration and learning by testing the new and emerging technologies through collaboration among themselves.

This is an exciting time in education. We now have technologies available to make a big difference in the quality of education by bringing together groups of learners from a range of countries and cultures. The technology is beginning to mature, and more and more educators want to take advantage of the advances in technology and educational practice that have been made during the past few years. As Web-based teaching and learning moves into the mainstream of educational practice, we hope this chapter will provide a guide for teachers as they design their courses and select software and services to support their goals.

REFERENCES


## URLs for Web-Based Software Discussed in this Chapter

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