Collaborative Learning Technologies

Maryam Alavi
Emory University, USA

Donna Dufner
University of Nebraska, Omaha, USA

Caroline Howard
Touro University International, USA

INTRODUCTION

Three basic categories of technologies are effective for extending collaborative learning beyond traditional face-to-face interactions to online learning and distance education:

1. Group support systems (GSS)
2. Collaboratories
3. Integrated learning environments.

Although some of the collaborative learning technologies can be used without the Web, the Internet and World Wide Web provide the scalable global connectivity to support these technologies, with the browser serving as a ubiquitous user interface for collaborative learning applications.

BACKGROUND

"Group support systems"[1] (GSS) consist of a wide variety of technologies configured to support group interactions. GSS typically feature software and hardware arrangements that facilitate asynchronous and/or synchronous intra-group interactions, enable groups to better coordinate activities and enhance group processes. For intra-group communications, GSS rely primarily on electronic mail and computer conferencing.[2] (Alavi, 1999). Both are especially popular and useful mechanisms for conducting technology-mediated collaborative learning that have been made possible and cost-effective due to the widespread availability of the Internet.

E-mail is an easy, readily available method for facilitating one-to-one and one-to-many asynchronous communications among members of the collaborative learning team. Because e-mail is a form of asynchronous interactions, senders and receivers of communications do not have to be online at the same time. The ability to send and receive messages at one's own convenience is particularly useful for collaborative groups distributed over more than one time zone.

Asynchronous computer conferencing also allows interaction without users being online simultaneously; thus, it is convenient for groups distributed across multiple time zones. "Threaded discussions," a popular form of asynchronous computer conferencing, consist of a series of related messages. Conferences may contain a number of threaded discussions on different topics. Each is an evolving, structured discussion that can be tracked and retrieved by team members interested in a particular topic. Because of its almost universal availability, the Internet has become the medium of choice for providing messaging and computer conferencing. Asynchronous computer conferencing systems have been very successful for supporting collaborative learning (Griffin, 2001). One such system, START Asynchronous computer conferencing, features an electronic bulletin board for messaging along with data management capabilities that organize and structure transactions.

Live, real-time "conversations" (interactions?) comprised of text messages can be conducted using synchronous computer conferencing. Prevalent GSS modes of synchronous communication are instant messaging and online "chats." These methods allow group members to communicate interactively with others using "channels." During these conferences, members are able to send and receive messages. Identifiers, such as group member names, are used to display the list of people participating in the conference and identify the sender of each message.

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For many years, multi-point videoconferencing systems have been used to provide courses to remote students in rural areas throughout the world. Synchronous videoconferencing consists of bi-directional, full-motion video and audio communication between two or more geographic locations. The Executive MBA program at School of Business at the Queen's University in Canada uses real time videoconferencing systems to transmit classes to students in remote sites throughout a number of time zones in Canada.

Collaborative learning applications can use these videoconferencing capabilities in combination with more advanced conferencing systems that allow screen and application sharing, collaborative brainstorming and group annotation. These capabilities can very effectively support real-time collaboration among small, geographically dispersed teams. For example, a 3-year educational project (HKNet) between the City University of Hong Kong (China) and the Eindhoven University of Technology (The Netherlands) focused on 178 student participants who used online communications to complete joint projects as part of their academic courses in software engineering, informatics and management (Vogel, Genuchten, Lou, Van Eekhout, Verneen, & Adams, 2001). For project communications, participants conducted both synchronous and asynchronous interactions using e-mail, videoconferencing, Internet phone connections and Group Support Systems (Vogel et al., 2001).

In another study, Alavi (1995) reported that point-to-point desktop videoconferencing and software application sharing was used to support collaborative learning by MBA student teams. Small-team collaborative learning generally has not used videoconferencing, due to the high cost of a necessary high-capacity bandwidth infrastructure. As the costs of high-quality Web conferencing systems decrease, smaller teams will be more likely to use videoconferencing when it would help the collaboration.

Support of collaborative learning teams is facilitated by key capabilities of GSS systems, especially the ability to coordinate, structure and organize tasks, processes and activities to support learning. Specifically, group project management software and tools can systematically direct the pattern, timing and content of group activities. For example, a group can generate and rank a number of solutions using a computerized Delphi Technique or can use computerized voting and tabulation tools to choose a course of action from a set of alternatives. GSS capabilities facilitating coordination and structuring of group activities can increase group effectiveness and efficiency by reducing group process losses (e.g., production blocking and evaluation apprehension) and enhancing group synergy.

In summary, group support systems are an effective medium for enhancing collaborative learning. Specifically, they perform a number of functions, including:

- Overcoming barriers in time and space that limit face-to-face collaborative learning interactions.
- Increasing group learning performance and effectiveness through mechanisms that coordinate and streamline group interactions, making them more efficient and reducing group process losses.
- Improving the depth, timeliness, format and range of information accessible to collaborative learning group members.

COLLABORATORIES

Transcending the usual boundaries of GSS and virtual workspaces, Web-based collaboratories offer a software environment that reaches outside the system for data, information and resources. William Wulf (1989, p. 2) coined the term "collaboratory" to describe a "… center without walls, in which the nation's researchers can perform their research without regard to geographical location—interacting with colleagues, accessing instrumentation, sharing data and computational resources, and accessing information in digital libraries" (Wulf, 1989; Kouzes, Meyers, & Wulf, 1996).

Collaboratories were originally developed by the scientific community. Since science entails "distributed knowledge work," electronic communication tools have long been used in the scientific community. "Electronic mail first became widespread within scientific communities" (Olson, Teasley, Bietz, & Cogburn 2002, p. 2), and in the late 1980s, scientists began to envision that geographically dispersed groups of scientists could work together using technology to access each other, databases, instruments and remote tools (Kouzes, Myers & Wulf, 1996; Finholt & Olson, 1997; Olson, Teasley, Bietz, & Cogburn, 2002).

Even though collaboratories have their roots in the sciences (Kouzes, Meyers, & Wulf, 1996; Barua, Chellappa, & Whinston, 1995; Wulf, 1989), they can also be used in conjunction with asynchronous

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