Web-Based Computer Supported Cooperative Work

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Key words: online interaction, cooperative work, Web, PT3, CSCW, CMC

Introduction

Computer-supported cooperative work (CSCW) has been a focus of research and development since the middle 1980s (Greif, 1988; Grudin, 1991), and business and industry have wasted no time in adopting CSCW techniques and technologies (Rein, McCue, & Slein, 1997). Educators, however, have shown less enthusiasm. Although proprietary network-based CSCW (i.e. commercial "groupware") is well established, implementing it usually involves considerable expense and technical expertise. More open (i.e., Web-based) systems are still in early stages of development, however, and do not always provide a sufficiently mature and stable base (Balasubramanian & Bashian, 1998). There are, however, inexpensive and widely available Web-based tools that can be assembled into workable, if not completely integrated, systems that can achieve many of the objectives of complex and expensive CSCW systems.

A CSCW system, by virtue of its collaborative orientation, usually involves a fusion of components designed to address a variety of tasks including preservation and development of organizational knowledge, document management, and computer-mediated communication, all of which are often mediated by a database system. The complexity of systems is brought on, in large part, by the requirement to integrate these systems into a single coherent whole.

Fortunately, higher-level integration is an area where people significantly outperform even the most powerful computing devices. People use tools within complex social frameworks and protocols that can help organize tools and tasks in important ways. Although sophisticated software management systems can help, workable solutions can be achieved with less than optimal technologies if the tasks to be supported are well-understood and effective social protocols are established to compensate for technological deficiencies (Davenport & Prusak, 1998, p. 5; Rein, McCue, & Slein, 1997).

In keeping with this orientation, we began by identifying a loosely organized toolset of familiar office applications and, over a period of approximately 18 months developed an interactive Web site to support project activities as the needs and interests of projects participants became apparent. Specific office applications were employed to establish standard formats for project materials and our Web-based system gradually evolved into our primary channel for both gathering and disseminating project information, support materials, and project-related documentation.

Project Overview

Our project focuses on three major objectives, all related to technology integration in P-12 or post-secondary classroom settings.

1. Assist preservice teachers develop teaching styles that make effective use of technology.

2. Promote preservice teacher use of technology-enhanced learning in their own education.

3. Establish a model for technology integration that can grow and change with technology.

We seek to achieve these objectives with a training and internship program that places digitally literate preservice teacher education students as technology consultants with established public school and university educators interested in learning more about technology integration. This consultant/client model is designed to introduce new teaching and learning technologies in a mutually supportive collaborative environment that benefits the preservice interns, the teachers with whom they work, and the students in the classrooms where technologies are introduced. The project is also intended to develop a broader, more flexible model for technology integration to ease technology transitions for individuals and institutions in a variety of settings.

Well before our first group of technology consultants began their work in the field, we had come to the realization that our success would depend on capturing what we were learning in a well-organized and accessible knowledge base. It was clear that, given our existing workplace practices, documents would be a central element in our knowledge base. Proposals and planning documents had been the foundation for our future work and had helped us establish timelines and assess progress. We also expected to produce a variety of user guides, project reports, and research papers. We were also well aware that managing the flood of paper generated by a large-scale project like ours could be difficult. Distribution of printed documents would create unnecessary and unproductive duplication, requiring participants to manage their own hard-copy document archive, as well as inviting versioning problems that arise when multiple drafts of a document are circulated.

One approach to solving these problems is to create a single centrally managed print document archive, but this approach is usually expensive and relatively inflexible, as a result of the administrative infrastructure that must be created to support intake, registration, and distribution. We opted for an alternative "distributed" approach to document management that allows individual project participants to submit, review, and retrieve documents through our project Web site. The foundation of this distributed approach is a database system that helps us organize materials, while it simultaneously solves problems related to versioning and duplication by providing a single readily accessible but authoritative source. One advantage we had in considering how we might manage the documents produced in our project was the fact that we had immediate control over our Web site, since the project Information Services Coordinator was also the server administrator. It has been our experience, however, that while this degree of control can confer some advantages (e.g., we can rely on our operating system to manage user access), the methods we have developed do not depend on this arrangement. Although working both sides of the traditional IT “divide” has given us an appreciation for the role of technology administration, our decision to emphasize low-tech tools meant we were looking for generic tools that would not require special server access.

Our server platform is a Windows NT machine running Microsoft's Internet Information Server 4.0. One feature of this platform that has been central to our project is its support for Microsoft’s Active Server Pages (ASP), an environment for integrating a variety of server-side scripting languages into our Web site, and Microsoft's ActiveX Data Objects (ADO) that support our database connections. Fortunately, however, these technologies provide relatively straightforward methods for creating dynamic database-driven pages without sophisticated programming skills, an important element in making our methods generalizable. Moreover, these techniques can be implemented in a step-by-step incremental fashion that helps those involved in developing and delivering information services acquire skills as they bring new capabilities online.

Overview of the Web-based Systems

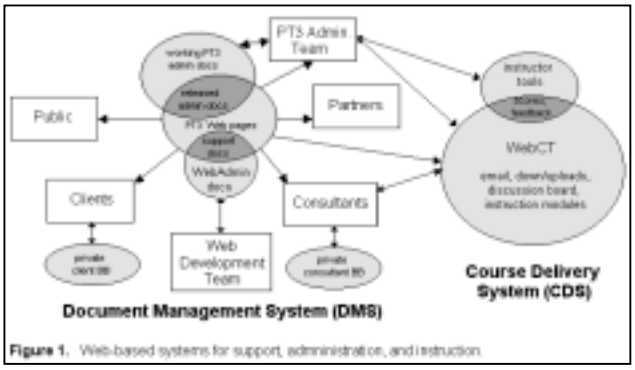


Figure 1. Web-based systems for support, administration, and instruction

As illustrated in Figure 1, our Web-based information system includes two main components, a document management system (DMS) and a course delivery system (CDS). The DMS runs on our project Web site, while the CDS (WebCT) runs on a university server. One disadvantage of assembling project-specific and university resources as we have done is that it requires participants to manage multiple user accounts (for access to different components), but participants have not reported problems managing accounts. Moreover, although these systems are distinct, we have found that information is easily shared since both components are Web-based resources on our local university network. While this arrangement limits our control somewhat, it also means we do not need to manage the CDS, a complex software system. All things considered, we believe our distributed approach has important benefits for both the sustainability and generalizability of our model.

Figure 1 provides an overview of our Web-based systems. Rectangular regions represent users, oval regions represent information, tools, and documents, and arrows represent the flow of information. Some groups are exclusively "consumers" of information, while others also contribute information to the system. Both the Web Development Team and the PT3 Administrative Team, for example, are linked to the DMS with double-headed arrows indicating they receive *and* contribute to this resource. Likewise, both Consultants and the PT3 Administrative Team are linked to the CDS, indicating that these groups participate as both consumers and contributors. In effect, these double-headed arrows represent the interactive elements in our system, places where participants contribute as well as consume information.

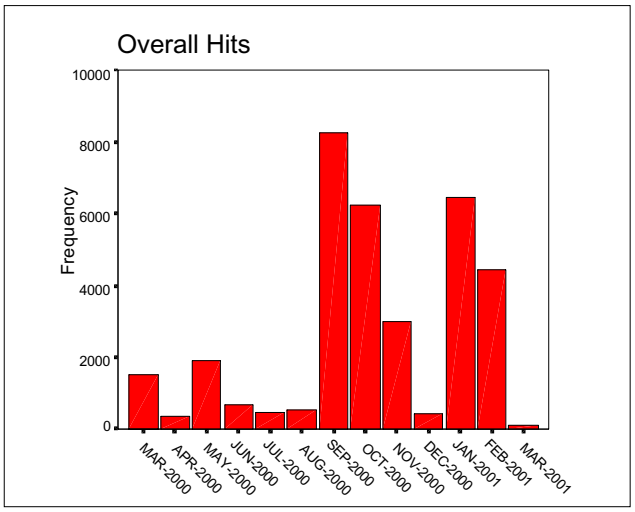
The DMS includes five main types of documents. The oval at the top represents documents created and contributed by the PT3 Administrative Team, the group of that leads the project. This part of the system supports operations that are "internal" to the administrative team. Most documents created by this group start out as restricted-access "working" materials, available only to other members of the administrative group. Some of these documents are, however, eventually moved out into the public area. The lowest central oval in the DMS represents a part of the system set aside to support development of support materials. Since members of the Web Development Team have primary responsibility for authoring these materials, this group has authoring privileges and is linked to the system with a bi-directional arrow. As with the administrative materials, support documents are initially held in a restricted-access region but usually move quickly into the public-access region. The final elements in the DMS are private, password protected discussion/bulletin board areas intended to promote and support *private* interaction within the client and consultant groups. As indicated by the arrows, only members of these groups have access to their respective discussion boards.

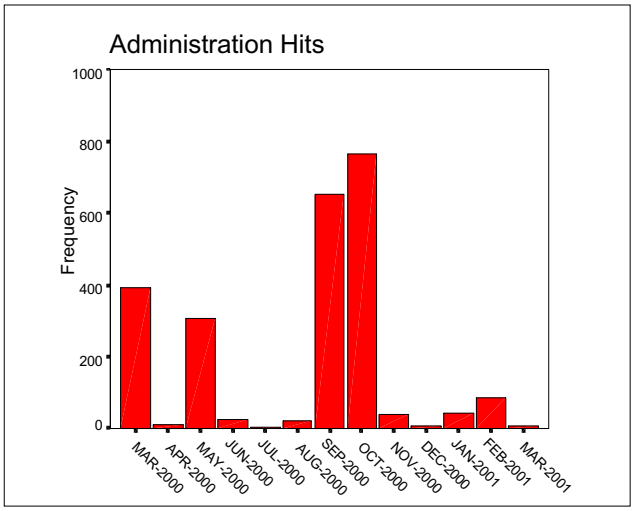
As indicated on the right side of Figure 1, the course delivery system (CDS) involves two participant groups, consultants and the administrative team. As a part of their project participation, consultants register for a 4-credit consulting course that helps them establish effective working relationships with clients (i.e., participating teachers.) Since our online

courseware includes a variety of interactive features, both consultants and members of the administrative team who co-teach the course are linked with bi-directional arrows.

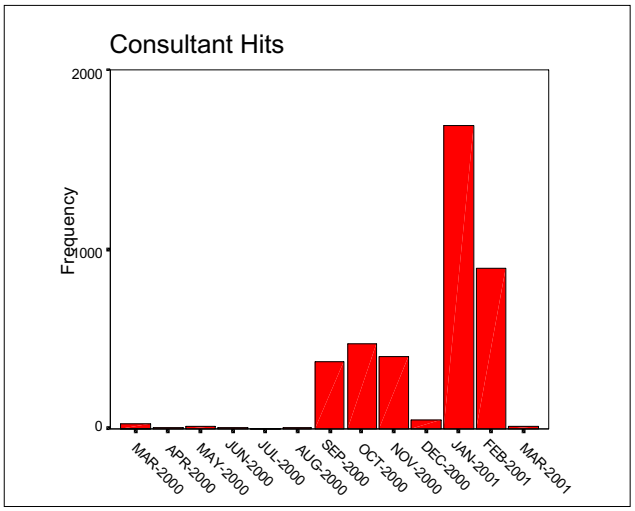
Data Collection and Analysis

Analysis of Web server logs revealed more than 34,000 Web site hits from more than 1000 different IP addresses over the 12-month period from March, 2000-March, 2001. There were clearly evident patterns in Web site hits, related to the university schedule. Overall hits in the spring of 2000 were low since the Web site came online in March and only 7 technology consultants were involved. There was, however, a dramatic increase in activity at the start of both the fall and winter terms in the 2000-2001 academic year with activity tapering off toward the end of these semesters.





Hits to administrative pages did not adhere to the more general pattern with larger numbers of hits in the spring of 2000 and no spike in activity at the start of the winter 2001 term as administrative pages were undergoing redesign at this time and were often unavailable. Hits to pages specifically targeting consultants also rose in a predictable fashion during academic terms but did not vary significantly across the months of the fall term of 2000. In the Winter of 2001, however, there was a dramatic rise in consultant hits as a new consultant "Job Board" system came online that allowed consultants and project personnel to track work activity.



Participant Perspectives: Project Director

As project director, my role is leading, coordinating, and making sure that all of the individuals involved have what they need. In order to do this effectively, I need relevant information about all aspects of the project and continuous two-way communication. Because my responsibilities also include teaching our student consultants, I am also in continuous communication with the students. I consider on-demand access to information resources and computer mediated communication essential ingredients in the success of our project. Our Web-based systems make my job much easier.

While our Web resources certainly facilitate the work of the PT3 administrative team, I am most fascinated by observing the use of resources by our student consultants. There is no question that they are personally experiencing the possibilities technology offers in support of learning. Our students have come to consider themselves a community of learners. They build on each other's knowledge through discussion boards and classroom interaction. They often answer each other's questions and provide one another support when challenges arise. They use the technologies at their disposal as just-in-time tools instead of just-in-case last resorts. Perhaps most important of all, they are not learning about technology integration in the abstract, they are actively applying technologies to meet personal learning needs in a way that will transform both their view of the tools and their ideas about teaching and learning. Although it is still too soon to know for sure how their experiences in the project will influence their future professional practices, what we see suggests they will be less likely to limit their future students to a "book learning" model.

Although we are pleased with the tools we have developed, what we have learned about how to more effectively support student learning leads us to conclude that we must continue to expand and develop the communication and information resources we deliver online. Administratively, we have created models that help us manage programs and create, store, and retrieve knowledge more efficiently and effectively. Further, I think we will find that many of our administrative Web resources will evolve into classroom learning support tools—teachers morphing into learning team managers—that's an interesting thought to ponder!

Participant Perspectives: Web Development Team

The primary focus of the Web team is to create support materials for use by consultants and clients. We began by identifying common technology tasks (e.g. how to create a Web page using Netscape Composer) and then created (or linked to) support documentation. For the most part we worked independently. An online "job board" (part of our WebAdmin site—see Figure 1) allowed us to choose a task, keep work records and, ultimately, upload the final version of our completed support material into our "PT3 Problem Solver Database."

In addition to regular Web team meetings, one team member attends meetings with consultants. This provides us an important user perspective on our support system, helping us learn how documents are being used, which documents are the most useful and what, if any, problems are encountered. We are also testing documentation in face-to-face consultant workshops in an on-campus computer lab. Hard copies of documentation are distributed to each consultant at the workshop. Consultants use the documentation as a primary learning resource to acquire new technology skills while Web team members observe their use of the documents. Consultants have an opportunity to raise questions both on a one-to-one basis as they work at a computer or in a group debriefing session immediately following hands-on learning. We have been very pleased with the quality of the feedback consultants have provided us, particularly in our workshop sessions.

Participant Perspectives: Student Consultants (based on interviews)

Overall, student consultants seem very pleased with the resources they are provided. Our discussion boards systems seem to have had the greatest influence in reshaping the way these students think about their learning. The students have begun using phrases such as "community of learners" in describing their experiences. Although one of our two discussion boards is private (the one in the DMS), we know from server stats that they are using this resource. Moreover, based on their comments in interviews, they appear to be differentiating their use according to their perceived role. Discussions that focus on consultants' roles as students appear more commonly on the CDS discussion board, while those that deal with field–based issues related to their roles as consultants appear more likely to crop up on the DMS discussion board.

When asked about whether they felt their PT3 experiences were likely to change their classroom teaching practices, consultants expressed strong opinions that their use of technology will be dramatically different that what it would have been, had they not participated. Consultants indicated they felt they had crossed both a "confidence threshold" and a "competence threshold", in addition to developing practical skills and ideas about integrating technology in classroom settings. It appears that fundamental mental shifts have taken place in the awareness of PT3 consultants concerning teaching, learning, and technology.

Summary and Conclusions

As a result of our Web-based management tools, project participants can interact and share their work with one another through the project Web site. Working groups usually have short weekly face to face meeting to talk over issues but our document management system has helped us automate processes that can be time consuming and error prone. Web Development Team members can select "jobs", track and annotate their work, record hours, and ultimately submit the work they complete (primarily support documentation) directly into the DMS, where it can be accessed by other project participants. A job completed and uploaded becomes immediately available to everyone else, something that seems to reinforce the important idea that the team is developing materials for users, not for their team leader. Our administrative systems have promoted the same sense of immediacy and audience in our project management materials and in the future we expect to initiate a similar consultant management system to help track and support our consultants who are working in the field.

We believe that our success thus far is due in large part to three factors. One factor is our decision to build our knowledge systems around Web technologies. A second factor is our decision to avoid high-tech proprietary systems (i.e. "groupware") in favor of a loose collection of relatively "low tech" tools (e.g., Microsoft Office, email, bulletin boards, and Web-enabled Access databases). And the third (related to the second) is to build on, rather than replace, our existing workplace practices and protocols. We also believe the model we have developed will generalize effectively. It requires only modest tools, modest levels of expertise, and modest changes in the working practices of participants. Once created, the technological and cognitive infrastructures that support the system are easily maintained and can continue to develop incrementally.

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