SUMMARY
◆ Argues that the technical communication field is expanding far beyond traditional areas of writing, editing, and production
◆ Describes research at the University of Washington that helps clarify the expanding scope of our field

Expanding the Scope of Technical Communication:

Examples from the Department of Technical Communication at the University of Washington

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INTRODUCTION

Most people have little difficulty distinguishing between activities performed by their doctor during a routine clinical visit and those performed by researchers in the field of medicine. While these activities are related, people seem to understand that day-to-day clinical activities such as taking histories, prescribing medication, and examining patients are very different (and far more narrowly defined) endeavors than scholarship, research, and development activities such as designing and conducting double-blind studies or developing protocols, drugs, and healthcare policies. It is curious, then, that many people, particularly those from outside our profession or academic field, equate the field of technical communication with the daily operational practices of technical writing—drafting, editing, and production. Why is it that people often lack an awareness of the scholarship, research, and development that establish the underpinnings and extend the application of these practices?

Even in its beginnings, the field of technical communication was not limited to the practices of writing, editing, and production. Technical communication as we know it today was largely born during the Second World War in response to issues stemming from the introduction of new technology to huge numbers of military personnel. While this response included a focus on the development of technical manuals, the general issues of supporting a mass, nonexpert audience in the adoption and effective use of new technology went well beyond technical writing.

Today in the U.S., academic, government, and industrial centers of research and development increasingly recognize that the value that technical communicators bring to projects extends far beyond technical writing, editing, and production. As examples, this article presents eight current projects involving faculty in the University of Washington's Department of Technical Communication that illustrate the broadening nature of the field. These projects address issues in wide-ranging areas: the cognitive processing of visual information, Web-based education, strategic management of information, communicating science and technology in the public arena, digital libraries, international adoption of information and communication technology, multimedia tools for international communication, and outcomes assessment of learning.

These projects, at varying stages of development, range from smaller, student-driven activities to well-funded, multiorganizational efforts. But they all share the attribute of demonstrating how current scholarship, research, and development efforts in technical communica-

tion build on yet range far beyond the "traditional" areas of technical writing, editing, and production.

A REVIEW OF SOME CURRENT PROJECTS

1. Tracking eye movements

Technical communicators engage in both quantitative and qualitative research, and are eager to adopt methods from related fields. For example, information about eye movements, such as fixation locations, durations, sequences, and patterns, has served as a source of data for psychologists since the beginnings of experimental psychology in the late 1800s. These kinds of data provide a window—if sometimes a somewhat crude one—into the nature of the basic attentional, perceptual, and cognitive processes humans employ in our attempts to extract meaning from a visual display or a block of text. Moreover, eye movement data can also help us to understand the ways in which the characteristics of a visual display (a picture, a block of text, a page in a publication, or a Web page) may influence either the processes by which humans attempt to interpret visual stimuli or even the resulting interpretations themselves.

In September 2001, the Department of Technical Communication at the University of Washington (UWTC) acquired an eye tracking system through a special opportunities grant from the Society for Technical Communication and an in-kind equipment donation from the eye-tracking system's manufacturer, Erica, Inc. The purpose was twofold: first, of course, the equipment was acquired to provide us with the necessary research tool to do eye movement research. Second and equally important was our desire to involve a great many of our students, both graduate and undergraduate, more directly in experimental research.

We believe that our graduates should be enlightened, critical consumers of the experimental research being done in our field. One very effective way to help students acquire the critical skills necessary to distinguish between good experimental research and flawed research is to involve them directly in the research process: to have them review the relevant literature, define an important research question, design a study, prepare necessary experimental materials, collect and analyze data, and present the results.

To date, two groups of five students each have run two separate experiments and are in the process of analyzing the data collected. One group investigated the effects of line spacing on the readability of type displayed on screen. They are working to clarify potential confusion stemming from the fact that current published recommendations for optimal amounts of spacing vary considerably (Tullis 1988).

The second group of students is examining the design principle of "emphasis" or "dominance." This frequently invoked principle states that isolating visual elements will attract disproportionate attention, yet the students could find no research in the literature to support this principle. Therefore, they decided to use the eye tracking system to analyze this untested assertion.

We support this type of scientific inquiry and expect it to continue for the foreseeable future and become an important facet of the experimental research we do at UWTC, particularly as we ramp up our recently initiated PhD program. If we accept the assumption that underlies eye movement research—that there is a relationship between what we look at and what we attend to—this kind of research may provide us with the kinds of data that allow us to speculate about the nature of the viewers' or readers' underlying cognitive processes. That knowledge, in turn, can serve as the basis for articulating principles for the design of visual displays such as Web sites that are both effective and efficient.

2. Supporting Web-based learning-at-large

The *Arthritis source* (www.orthop.washington.edu/arthritis) is an informational Web site that provides extensive, authorized (by the University of Washington Medical Center), arthritis-related information to users with access to the Internet. The original *Arthritis source* was developed in 1995 by Dr. Frederick Matsen of the University of Washington. The *Arthritis source* has served as a testbed for research and development since 1999.

Work on the *Arthritis source* has focused on

1. Adding more content.
2. Extending existing content.
3. Helping users find relevant information.

In addressing these issues, researchers from UWTC have joined with researchers from other fields (particularly the health sciences) to find solutions that are scalable (so that we can continue to expand the site) and enhanceable (so that we can make changes with reasonable levels of effort). Figure 1 presents the main page of the current site.

The site has a number of distinguishing features.

◆ **Template-based content**   Content in the site is organized into articles, and the site currently contains over 100 articles. New articles are written according to templates designed around major article categories (for example, conditions, medications, surgeries). The templates, which are sequences of questions that authors must answer, specify the coverage and sequence of the article content and provide standardized headings and keywords.

◆ **Multiple access paths**   Users can access site content through multiple paths including browsing, standard keyword search, and question-based search. Our implementation of the question-based search matches user questions to template questions
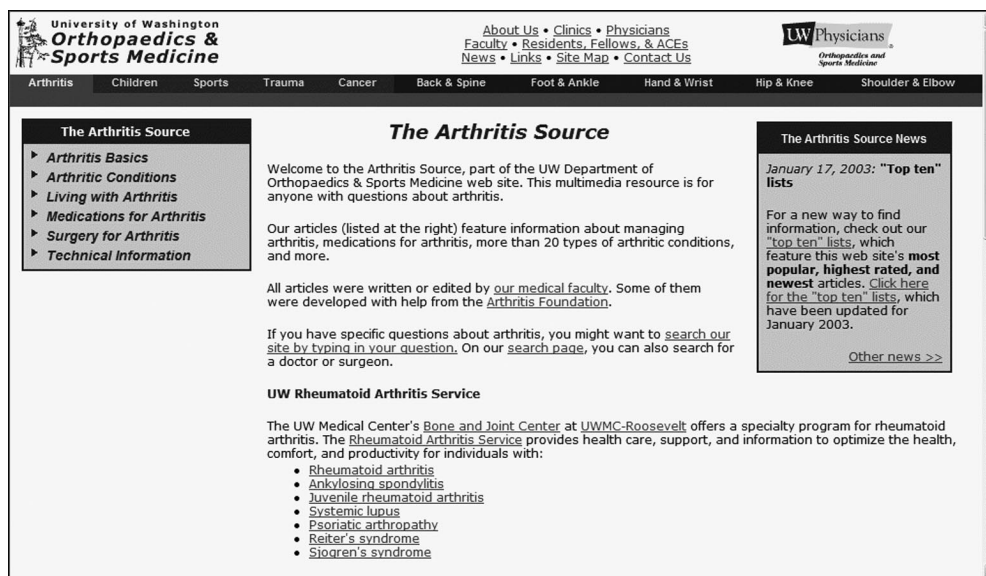
Figure 1. The main page of the *Arthritis source*.

(rather than matching user questions to site content) and asks users to select from among the suggested questions. When users click on one of the suggested questions, they are taken to content that addresses the question.

◆ **Embedded evaluation** The site includes many forms of embedded evaluation. Users can rate content on simple scales, submit feedback through e-mail, participate in online surveys, and participate in formal online studies.

Examination of *Arthritis source* activities illustrates how research and development in technical communication builds on but goes beyond traditional tasks in technical writing. At the heart of the *Arthritis source* is a need to effectively communicate technical information about medical conditions, treatments, drugs, therapies, and so forth to a variety of users. Clearly, standard practices of effective writing and content creation are vital. However, work in the context of the *Arthritis source* illustrates a broader perspective on what such issues can entail.

For example, in the context of this effort, content creation rarely means a professional author determining and creating appropriate material; far more often, it means supporting the efforts of multiple authors who are not professional communicators. Following is discussion of how audience analysis, authoring, and design activities are expanded within the development of the *Arthritis source*.

Audience analysis Audience analysis is critical to effective technical communication. An understanding of the audience can lead to a better understanding of the opportunities and challenges in technical writing. In the context of the *Arthritis source*, we have asked, What are the distinguishing features of the audience of Web-based health information systems, particularly in the domain of arthritis?

As Schriver (1997) points out, there are multiple perspectives on audience analysis—from an intuitive perspective to an empirical perspective. Our approach to audience analysis has been significantly empirical (Liu, Turns, and Wagner 2001; Tanada, Turns, and Wagner 2001a–d; Turns and Liu 2000; Turns, Liu, and Wagner 2002; Turns and Wagner 2002).

We have drawn on a variety of mechanisms for gathering data to understand our audience. These data collection mechanisms have included an online survey (with over 400 respondents who participated by following hypertext links), a semi-structured phone interview (with 20 participants), observations of informal educational activities (with approximately 75 participants), and collection of user questions (from over 300 users).

Through these mechanisms, we have gained knowledge about our audience's purpose, their self-identified roles when interacting with the information source, their background knowledge, their location and culture, their circumstances of use, and their cognitive and perceptual abilities.

For example, we have found that typical visitors to the *Arthritis source* are individuals with an arthritic condition, 41–60 years of age, who live in North American suburban communities with easy access to general practitioners and

specialists. They typically use search engines or follow Web site links to find information on the Internet (Turns and Liu 2000). We have learned that users often have significant misconceptions about the nature of bone spurs, misconceptions that can affect how people process the information on the Web site (Liu, Turns, and Wagner 2001).

Influenced by ideas from the learner-centered design movement (Soloway, Guzdial, and Hay 1994), we have characterized our data on the three learner characteristics of diversity, engagement, and growth (Turns and Wagner 2002). We have also documented a small number of general goals and a large number of specific information needs in the content of the system. This empirical, research-level audience analysis has influenced our overall design, including templates (the template structure is based on the needs of the audience) and the need for the question-based navigation (the wide number of specific information needs suggested that approach to navigation).

Authoring   One goal of the *Arthritis source* work has been to support growth in the amount of content authored. Another goal has been to make it possible for other groups to create informational site content based on our lessons about content creation. Clearly, the authoring of technical content is critical to the technical communication profession.

Technical communication professionals work hard to perfect their skills at writing content that is readable, simple, clear, and effective. A challenge of the *Arthritis source* work has been the recognition that our team cannot be the authors of the content, nor can we assume that formal technical writers will be the authors. Thus, our goal has been to find ways to help others effectively author technical content.

We are addressing this issue with the creation of the content templates so that the templates communicate the audience needs to the future authors (Shuyler and others 2002). Additionally, we have created a Web-based environment where authors write articles using these templates. The support environment provides additional writing resources, such as example text and navigation between the authoring environment and the published article. Collectively, the templates, example text, and writing environment serve as an online toolkit for content specialists, guiding them in the creation of effective materials for their audience.

We are currently evaluating this support environment by working with doctors and medical students who are creating content using the templates. In our evaluation, we are looking at their perceptions of the template, the quality of the resulting articles, and the challenges that the authors face. We are also exploring how to port this template-model to other domains, such as the creation of a legal

"wellness" informational Web site and the creation by students of a Web site on alternative, environmentally friendly building methods (such as straw bale construction). Finally, we are exploring how the template-authoring process enables diverse models for ultimately getting the content authored.

For example, one model involves students working together to fill out the templates with an overseeing faculty member signing off on final content. The key observation here is that our role as technical communication professionals has not been to write content but rather to support the effective writing of content by others.

Designing communication support by designing information, inquiry, community, and learning support   Throughout this project, we found that to support effective communication we had to design at several levels. In a view of technical communication centered on technical writing, the essential design activity is that of writing content. But because of the electronic nature of the *Arthritis source*, our design efforts also included creating flexible support of users' access to information and efforts to work through their inquiries.

For example, our Web designer role includes the design of navigation elements to access content. We also have great flexibility in designing the information itself—both in terms of the organization of information as well as the visual properties of the information (such as fonts and colors). But most importantly, because our audience analysis has shown us the extent to which our users come with specific questions, we recognize the need to design to support the user's inquiry—helping users get to the information they wish to have. This recognition has led to a design built on question-based searching that enables users to find and read content relevant to their larger question.

We are also significantly involved in designing to create community and to support learning. By framing the *Arthritis source* as supporting a community rather than simply providing an information source, we have been able to identify a number of powerful roles that users can play that support the effective communication of content. The users in the community can contribute to the evaluation of the content (by rating content), to the scope of the content (by submitting requests for information), and by interacting with other members of the community (by seeing the questions that others have asked). We envision, at some point, permitting users to get information by letting them interact with other members of the community.

To be effective, the *Arthritis source* needs to be able to successfully communicate content to its users. The various activities that we have used to accomplish this goal illustrates a broad vision of technical communication.

3. Technical communicators and the strategic management of information

The broadening perspective of technical communication includes the realization that technical communicators are well suited to address the complex, multidisciplinary issues surrounding effective use and management of information. This realization was demonstrated in a large, multiorganizational effort to study the lessons of the Y2K phenomenon for strategic information management.

In reading the following brief description of this project, keep in mind that the National Research Council (NRC), arguably the premier research institution in the U.S., chose a professor of technical communication and two technical communication graduate students to lead and conduct this work. We need to consider what this fact says about our field and future opportunities in corporate roles such as Chief Knowledge Officer and even Chief Information Officer.

In 1998, the NRC launched a series of planning meetings to position itself to take advantage of what was perceived as "an extraordinary opportunity to learn . . . how various factors, including current management structures and practices, impact . . . risk that threatens serious damage to information and other critical infrastructures" (NRC). The initial focus of these meetings was on vulnerabilities stemming from "the interconnectedness of complex 'systems of systems'" and a goal was set to gather comparable data on such a complex system both before and after the 31 December 1999 rollover.

The organizing committee recognized that key issues ranged beyond technology and included aligning the multiple perspectives of information owners, users, and audiences, as well as establishing mechanisms for effective human and organizational communication of critical information. It was issues like these that led to the selection of a technical communicator as principal investigator on this effort.

In early 1999, the Institute of Electrical and Electronics Engineering became a sponsoring partner of the project. In mid-1999, the NRC team began working with U.S. Air Force personnel to set up a case study of Y2K and the Air Force. Sets of interviews were conducted at a stateside and overseas base both before and after the end-of-year rollover. These interviews involved both working groups and policy-making units on these bases. Supporting phone interviews were conducted throughout the project. Then, on 14 April 2000, an all day Air Force-wide "Y2K lessons learned workshop" was held in Washington, DC.

The resulting story was that of an extremely large, technologically dependent, global organization and its efforts to counter a widely dispersed, simultaneous threat to its information infrastructure (Haselkorn forthcoming). This story involved numerous disparate and interrelated elements that changed over time, and it presented many seemingly contradictory perspectives. But in the end, it was a story rich in hard-won, often painfully acquired insights into the effective management of information and supporting technology.

Y2K was a unique event for the Air Force, as it was for most organizations that rely on information and communication technology (ICT) to accomplish their mission. The Air Force response to Y2K evolved over more than 5 years. It ultimately involved thousands of people throughout 108 bases interacting in varying, often nontraditional (to the organization) ways to address perceived threats.

In addition, hundreds more people at numerous major Air Force units were active in developing guidance and support packages, and in monitoring their implementation, whereas personnel involved in the acquisition, design, development, fielding, maintenance, security, and use of systems and applications also responded from their particular perspectives. Whatever the state of an organization's strategic management of ICT, Y2K stressed existing practices in completely new ways.

To understand the story of the Air Force and Y2K, it was necessary to be aware of a wide array of critical issues pertaining to the evolving strategic management of information and the "new infrastructure" that makes this information so potentially powerful. The case study provided lessons under three interrelated headings:

◆ Lessons for managing ICT complexity
◆ Lessons for aligning organizational and ICT strategies
◆ Lessons for managing ICT risk, including infrastructure protection and assurance

In each area, lessons were derived from the analysis of interrelated and dynamic responses of various Air Force elements to the perceived threats of Y2K.

The fact that Y2K did not result in widespread catastrophic failures has led many people to quickly forget the experience, yet the lack of obvious impact actually made it a richer source of critical lessons for strategic management of information and communication technology. Rather than being a story of fundamental flaws and cascading effects, it was a story of maintenance and modernization, life-cycle management of systems and software, functional interdependency and continuity, guidance policies and certification, system ownership and responsibility, training and organizational roles, security and information assurance, and system vulnerability and robustness. Y2K tested the evolving Air Force system for management, modernization, and protection of information and its supporting infrastructure.

The result of this work was partly specific to the U.S. Air Force, and the conclusions and recommendations were tailored to its interests and needs. However, it was not just the story of an Air Force problem. Every organization that

relies on ICT to accomplish its objectives faces the same difficult challenge—how best to manage the totality of their ICT assets within the context of their organizational environment and strategic objectives. The challenges of managing information and its supporting infrastructure are common to all modern organizations.

This project demonstrated that the complexities of managing information center on the alignment of multiple perspectives among information owners, creators, and users representing differing organizational activities. The analysis was essentially rhetorical, centering on understanding the various audiences and their situations. The rhetorical nature of this analysis makes technical communicators uniquely qualified to help uncover and address these complex but human-centered issues.

4. Communicating about science and technology in the public arena

In addition to the various roles already discussed, technical communicators also have a critical role to play in the process of bringing information about advances in science and technology to diverse audiences. At UWTC, several research and educational projects are aimed at better understanding and enhancing the process of reporting the latest developments in science and technology.

The dividing line that may have existed in the past between the fields of technical communication and science journalism are now blurring, thanks in part to the World Wide Web and the development of new digital media. Today, technical communicators are concerned with the design of content about advances in science, medicine, engineering, and other technical fields, whether for the Web, for multimedia products, or for news articles, press releases, brochures, newsletters, and annual reports.

Technical communicators are called on to negotiate among technical sources who generate new knowledge and technologies; with journalists, who report the news in print, broadcast, and Web formats; and with various sectors of the public. Furthermore, technical communicators are entering the field of technology journalism themselves, as evidenced by the creation this year of a new technology journalism internship at *IEEE spectrum*, the flagship magazine of the Institute of Electrical and Electronics Engineers, and the appointment of a UWTC master's graduate to the position.

The centerpiece of our effort at UWTC, however, is *Northwest science & technology magazine* (*NWS&T*), which serves both as the basis for an experiential learning curriculum in technical news writing and as a research platform for empirical studies in technical communication. It was launched March 1999 as a publication of the University of Washington with editorial headquarters in UWTC.

Four main forces converged to bring about the launch of *NWS&T* (Illman 1998). First, science and technology news writing was identified in a poll of UWTC students as an area of curriculum expansion that would be of interest. Second, at about the same time, there was a growing sentiment within the Northwest U.S. region that developments in science and technology were not being adequately covered by traditional news media. The Pacific Northwest has experienced tremendous growth in science and technology activities over the past decade in academic as well as corporate sectors, especially relating to software, the Internet, and the biotechnology and biomedical fields. Two further trends within the University and at the national level provided additional impetus: the Boyer report and the new Accreditation Board for Engineering and Technology (ABET) Engineering 2000 criteria.

The report of the Boyer Commission on educating undergraduates in the research university had been issued in April 1998, challenging research universities to rethink their approach to undergraduate education. Research universities were urged to draw on their strengths as research-based communities to make learning based on discovery and guided by mentoring, rather than based simply on the transmission of information. The report identified 10 challenges facing research universities—among them, removing barriers to interdisciplinary education, linking communication skills and coursework, and culminating undergraduate programs with a capstone course.

Spurred by the Boyer report and other forces, the University of Washington moved to transform and invigorate its programs, establishing an internal funding mechanism called Tools for Transformation that supported the development of a technical news writing curriculum in UWTC as a part of a larger effort to encourage experiential learning in the University of Washington College of Engineering where UWTC is administratively located.

At the same time, colleges of engineering across the country had been gearing up for the 3-year phased implementation of the Engineering Criteria 2000 promulgated by ABET. The ABET criteria require engineering programs to demonstrate that their graduates have gained proficiency in 11 key areas, including the ability to communicate effectively, a broad education necessary to understand the impact of engineering solutions in a global and societal context, and a knowledge of contemporary issues.

A technical news-writing curriculum linked to the production of a regional magazine thus provided a means to address key issues raised both by the ABET criteria and the Boyer report, while furthering UWTC goals in teaching and research, and providing a public service to the community.

In addition to serving as an outlet for student writing (roughly 50–70% of each issue is student-authored), the magazine provides the context for graduate research. Our work has focused on studies of accuracy and uncertainty in
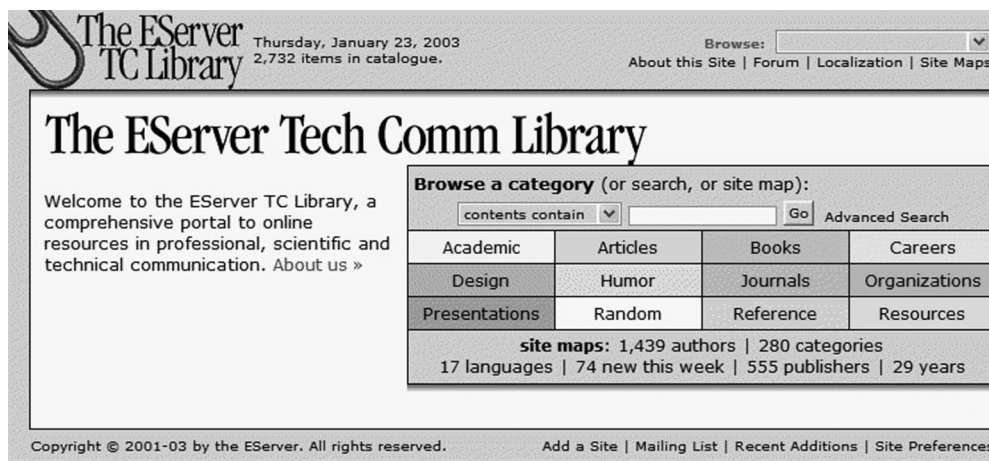
Figure 2. The EServer Tech Comm Library.

technical news reporting, and on the civic role of scientists and engineers.

Research (Tankard and Ryan 1974) has shown that science news reporting has higher error rates than other types of news content, and, indeed, writing about technical news presents daunting challenges in terms of explaining abstract, unfamiliar, or counterintuitive concepts, discussing uncertainties and risk, and reconciling differing viewpoints.

Adding to the complexity is the fact that very often, technical sources and writers disagree about what constitutes accuracy in news reports about science and technology. Studies reported previously in the literature on accuracy of science news have not employed a uniform scheme for collecting and coding data on types of inaccuracies. Based on our research at *NWS&T*, we have developed such a codification scheme (Carsten and Illman 2002) that may lead to strategies for enhancing the accuracy of popular writings about science and technology.

Other work in our laboratory has focused on analyzing the role of scientists and engineers in communicating about science and technology in the public arena. As a first step, we have identified and characterized five main modes of interaction of technical sources with the public, and we have analyzed the different goals and outcomes of these modes (Clark and Illman 2001).

The concept of the "civic" scientist or engineer has received much national attention over the past several years. According to Neal Lane, former presidential science adviser and former director of the National Science Foundation, the civic scientist is one who "engages the public in a dialog about science and society" (1998). Although most agree that encouraging the development of civic scientists is a necessary and desirable goal, the exact role and nature

of the interaction of scientists with journalists and members of the public remains problematic. Along with many other, often related, roles, technical communicators have a key role to play in clarifying our evolving notion of the civic scientist.

5. Lessons from a digital library

Online institutions can be used to help clarify the expanding scope of our profession for both subject matter experts and members of the profession, and the EServer Technical Communication Library (Figure 2) is a Web portal designed to do just that. This project (http://tc.eserver.org/) was planned from the outset to help clarify online representations of the profession. The site provides a detailed annotated bibliography of online resources in the technical communication field with ratings, reviews, and discussion of these works (at the time this article was in press, more than 2,700 in all). It also publishes a few original papers.

The site was created in a collaboration between UWTC and the nonprofit academic publisher EServer. It was begun after a UWTC research group noted curious dichotomies in technical communication Web sites in April 2001. We found that some sites were dedicated to practitioners, publishing information primarily about tools and techniques. Others were written for academic audiences, with resources for teaching and publishing, and some discussion of future directions for the field.

A third category of Web sites was dedicated to fields that overlap with technical communication, including usability, human-computer interaction, and content management, but they did not identify themselves explicitly with our field. There seemed to be links connecting these discrete site categories, but there was no evidence of any coordinated efforts to span the divide and provide a uni-
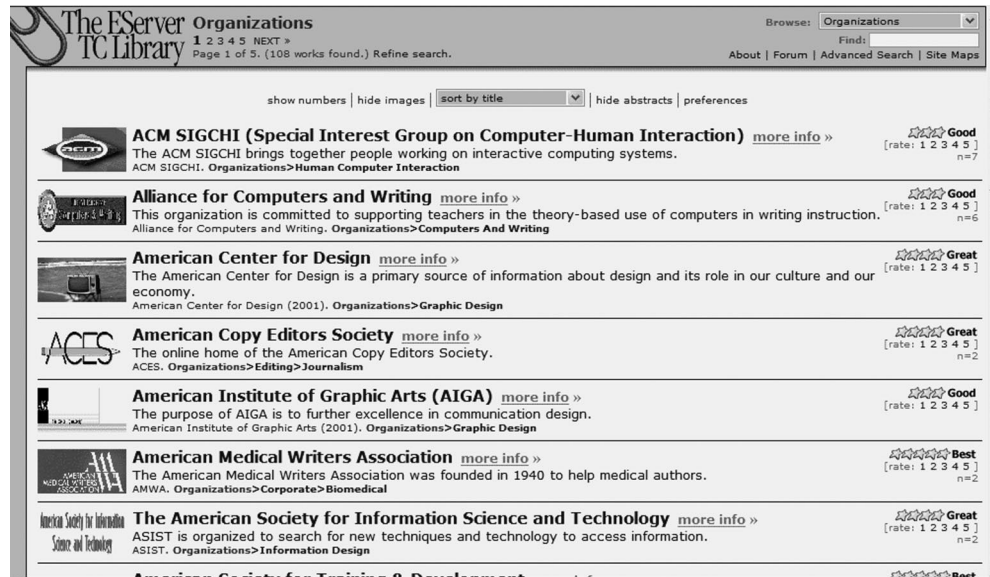
Figure 3. The EServer TC Library "Portal View" of Contents.

form "technical communication" interface to these audiences.

Consequently, the research group chose to develop a database-driven Web portal, with a user-centered design approach to target all three audiences within a single interface, to provide resources for people in the field while also providing a coherent representation of the field to those new to it. Today the site has active advisory and editorial boards whose members include university faculty, professionals with industry experience, and editors who represent practitioners' interests in several specialties.

In our work to create and develop the resource, we encountered three specific issues that expanded our notion of information design in technical communication.

Based on early research on genres targeted simultaneously to multiple consumer audiences (Clark 1991; Straub 1991), we sought to develop a Web application that would interest the three constituencies mentioned above. Some categories from the home page were created specifically to appeal to particular groups ("Academic," "Careers," and "Organizations," for example), though the system was also designed to display search results that combine academic, professional, and practitioner perspectives to enable a cross-pollination we felt was not found in other online resources.

The site's extensive use of the familiar genre of the Web portal assisted greatly in this task. The majority of users quickly recognized the interface, whereas high-end users (roughly 25% of visitors) have made use of the site's detailed "Site Preferences" (Figure 3) interface to create a customized interface to the information on the site.

Our site development involved iterative usability testing, including early Web surveys, then focus groups and two traditional usability testing protocols to improve the interface. The findings from this testing told us that our audience had more exacting standards for Web site design than other reported users (Meaney 1998; Nielsen 2000). This discovery required reallocation of resources to develop improved search interfaces, more accessible navigation, and detailed display of ratings statistics, among other details.

The structure of a URL is not usually considered a technical communication issue, but users have identified one problem with Web portals to be the long, user-unfriendly URL addresses generated by the conventional HTTP "GET" method of sending query information to a Web server. Therefore, our team added a German software product, Pardeikes Welcome, to modify category URLs. For example, the EServer TC Library revised its URL addresses so that rather than natural HTTP GET request URLs for resources in design specializing in usability, such as

http://tc.eserver.org/tc.lasso?c1=categoryall&op1=
bw&cat =/Design/Usability&-maxresults=
15&-sortorder=ascending&-sortby=title&-search

the URL of EServer TC Library for such a category will appear as the more succinct:

http://tc.eserver.org/dir/Design/Usability

The resulting page is still dynamically generated from a server database, but the system masks the database query and displays a more familiar URL address. From log analysis, we can ascertain that this approach has met with highly successful results; fully 20% of requests for specific categories come from users' browser "bookmarks"—a significantly higher percentage than is common for Web portals (Healy 1999).

Our user interface also provided numerous other search interface elements, including a four-level hierarchy of categories, full-text search, search by rating and by particular authors or publishers, and an interface to customize the sorting and display of results.

Although commercial interest in the 1990s in online communities has made many users cynical and created problems for some contemporary attempts to develop online community facilities (Werry 2000), the EServer TC Library extended a model found in the Society for Technical Communication's academic programs database (www-.stc.org/academic.asp), adapting the model to permit active participation by our users.

Although the STC Web site restricts access to some of its content, the STC Academic Programs Database permits anyone to add or modify information about any academic program. Open access permits the database to remain more up-to-date and accurate than would be the case without community input. This has worked for STC because the technical communication community is small and relatively closely knit, and there have been no reported cases of "hacking" the site to spoil the open access approach.

The EServer TC Library followed the STC model, with "add site" and "update site" interfaces to allow our users to either add or edit resources. This approach has worked remarkably well, with over 600 sites thus far having been added by users outside the original project team—only two of which were deemed inappropriate and removed by the editorial board. The "Join the site" page lists the names of everyone who has added resources to the Web site. And Web survey testing informs us that the site's recognition of contributors has increased participation in both the site's listserv and threaded Web discussion forums.

Announced on 1 January 2002, the EServer TC Library's audience has grown rapidly; as of November 2002, it hosts approximately 20,000 visitors per month. The range of visit length peaks between 4 and 8 minutes, significantly longer than the reported standards for other Web portals (Ramey 2000). Since then, the site has grown to include links from 571 other Web sites, a fact that caused it to move up to the fourth among Google results of searches for "technical communication."

To be effective, the EServer TC Library (like the field as a whole) needs to communicate two things to its users:

relevant content to address their interests and an overall view of the context as reliable and consistent with "best practices" (Miller 1979).

6. Understanding cross-cultural patterns of adoption and use of information and communication technology

As use of the Web proliferates across the globe, understanding the perspectives and addressing the needs of Web site users becomes a cross-cultural problem. Technical communicators can contribute significantly to this added dimension of user analysis.

Using Central Asia as a testbed, two UWTC researchers have been investigating what cultural factors are most operative in determining whether and how a population is likely to make use of ICTs. The goal of this work is to advance understanding of how information technology is perceived, used, and reconfigured in diverse cultures. The project responds to continual questions being asked about the concept of a digital divide, conversations that can tend to repeat similar concerns rather than advancing the state of knowledge.

Deeper inquiry into the idea of a digital divide requires a multifaceted and interdisciplinary understanding of technology, users, and culture. Technical communicators are best positioned to make these kinds of assessments because the discipline concerns itself specifically with rhetorical issues such as audience and purpose in conjunction with technical capabilities. In other words, an international perspective on how people make use of ICT demands awareness of users' disparate needs in terms of infrastructure, tasks to be completed, cultural context, and the overlap and potential conflict of technology with these other factors.

By conducting an empirical investigation into the cultural factors that affect information technology adoption and by articulating what factors are most significant in determining the success rate of ICT initiatives, this research will provide a blueprint that can be used by programs delivering ICT-related programs in disparate settings.

The research includes administering questionnaires at Internet access points throughout the region and conducting interviews with ICT users and policymakers. Central Asia was chosen as the site of the research because of that region's unique combination of infrastructure and literacy combined with early stages of Internet adoption and a relatively low exposure to Western culture. An early stage of this project was conducted when one of the researchers received a Fulbright award to work in Uzbekistan. The project is continuing with funding from the National Science Foundation.

As research on the digital divide has expanded and studies have considered how factors apart from economics

influence the likely success rate of ICT initiatives, other variables have been acknowledged as operative in maintaining the divide. Some research ties the issue of access to the related idea of experience (Smolenski 2000). Yet another body of work acknowledges that factors such as race, age, gender, and culture contribute to gaps in technology use.

What is most important in this work is that it considers not just gaps in whether ICT is used, but *how* it is used (Hill 1999; Weinman and Cain 1999; Cullen 2001; Boneva, Kraut, and Frohlich 2001). Increasingly, researchers are acknowledging social factors that affect the ability of an ICT initiative to succeed (Liff and Steward 2001). Investigations of attitudinal factors have also been conducted (Cullen 2001; Jackson and others 2001). Overall, the facile notion of a digital divide focused on questions of access has been replaced by an acknowledgment that technology is embedded in larger economic and social systems.

Furthermore, ICT is embedded in political systems, bringing yet another realm of consideration into play (Kvasny and Truex 2001). Large-scale international programs, such as the 2001 initiative by the United Nations in conjunction with the World Bank and the International Telecommunications Union (Roach 2001), designed to address the digital divide on a global scale, address the complexities of a digital divide in a variety of ways. Indeed, access remains an issue in lesser-developed countries, and the disparity between users who rely on broadband technologies to access the Internet versus those who use lower-speed access devices results in disparities over usage (James 2001). This issue is relevant in the U.S. as well.

Even granting universal high-speed access, though, will not completely bridge a divide that is informed by cultural factors. The importance of understanding the political, cultural, and other factors that cause differential rates of ICT use is tied to ICT's well-established ability to affect other factors such as broader economic development and education (Negroponte 1996; Lentz and Oden 2001; Arunachalam 1999).

In addition to general political culture, public policies of communities and countries contribute to how ICT initiatives take root or the directions in which they grow (Guillén and Suarez 2001; Lessig 1999; Strover 2001; Norris 2001; Baker 2001). The ability of policy to substantively affect the development of an ICT industry is one component of this equation. Another is the question of how policy intersects with attitudinal factors such as willingness to overcome barriers to entry, tolerance for censorship, and willingness to be a nonanonymous or monitored user.

The relationship of policy to the success of ICT initiatives has not been thoroughly addressed by the literature, and one goal of our UWTC research is to generate a more complex understanding of the chain of influence between policy and usage.

Overall, studies that acknowledge the different factors influencing gaps in ICT use make it clear that understanding local conditions is crucial for the success of a program. Recent research has shown that integrating information technologies in diverse settings requires flexibility and an understanding of local needs. However, these studies have focused on analyses that attempt to explain usage patterns rather than using information about cultural difference and other factors to guide implementation plans for ICT projects. In many ways, creating an effective ICT implementation project is about design—designing for the technology, the users, and the culture.

A great deal of cross-disciplinary work has helped establish the important role that design plays in effective cross-cultural communication (Bradley 2001). For more than 30 years, researchers have been aware of the critical role of both content and structural schemas in guiding how readers interpret information (Ausubel 1968; Pearson, Hansen, and Gordon 1979; Anderson and others 1977), and in the past 20 years, extensive research has shown that readers' or writers' culture strongly affects how they interpret the content and structure of information (McClure and others 1983; Carrell 1984a; Carrell 1984b; Carrell 1987; Lipson 1983; Jenkins and Hinds 1987; Johnson 1981; Spyridakis and Fukuoka 2002; Steffenson, Joag-Dev, and Anderson 1979).

Educators are well aware that second language learners are impeded by their lack of cultural understanding of common rhetorical structures in that second language (L2) and accept that they must address the gap in the L2 curriculum (Barnitz 1986; Clarke 1978; Clarke and Silberstein 1976; Opitz 1998). And technical communicators are realizing the need to adapt documents and screens to the needs of readers and users in other cultures (Fukuoka and Spyridakis 2000; Fukuoka, Kojima, and Spyridakis 1999). The business and healthcare communities have realized that many breakdowns in the success of business dealings or even health compliance have been caused by failing to attend to and honor cultural differences (Artemeva 1998; Huerta and Macario 1999; Stern 1986).

Such work in cultural schemas is one of the intellectual underpinnings of how technical communication can help us better understand international uses of ICT. Cross-cultural adaptation of communication is a recognized need, one that remains relevant for new media. Content and rhetorical structures are not the only factors subject to cross-cultural considerations; communication systems and structures are also embedded in cultural formations.

Indeed, because local conditions generate disruptions in expected Internet use, researchers are trying to generate methodologies that can adequately capture the complex series of factors that influence both people's adoption of

Internet technologies as well as their usage of those technologies. Technical communication as a discipline can make a significant contribution to this kind of inquiry.

7. Multimedia software for international communication

Another international focus within UWTC is the Technical Japanese Program (TJP). TJP is an interdisciplinary program concerned with the international aspects of technical communication. A basic assumption of this program is that international communication skills are fundamental to effective international technical communication. Based on this assumption, TJP's research focuses on the development of foreign language skills for technical/business communication and particularly on the use of technology to enhance this development. This work has led UWTC faculty to expand their roles into new areas of software development for language learning and international communication.

TJP has developed several important computer-assisted learning programs for language training. Language Partner (LP) is an interactive multimedia program that assists foreign language learners in acquiring oral communication skills. Using the most recent multimedia technologies, LP provides a practice environment that simulates real situations so that learners respond as if they were conversing with actual partners. In conjunction with this environment, the program's step-by-step approach allows students to rapidly learn effective communication skills.

LP provides learners with a simple and easy-to-use interface consisting of three sessions: a Preview Session, a Repeat-after-me Session, and an Interaction Session. In the Preview Session, learners view a given dialog from a third person's point of view and understand its linguistic and cultural content (see Figure 4). Cultural content includes such things as the relationship between the speakers, the different modes of the language used by the speakers due to the difference in status or gender, manners (for example, methods of greeting in business or social situations), and gestures (for example, nodding and hand gestures). Learners have on-demand access to dialog texts and their translations to check comprehension, and so forth. (Dialog texts and their translations can be accessed in other sessions too.)

In the Repeat-after-me Session, learners practice dialog by repeating a chosen speaker's words while watching that speaker on the computer screen (see Figure 5). During this session, learners not only practice accurate pronunciation, intonation, and timing of utterances, but also the body language appropriate to the situation. In this way, learners internalize both verbal and nonverbal components of the dialog. After practicing, students can record their utterances and compare their performance with the model.

Finally, in the Interaction Session, learners take the role of one of the speakers and practice the dialog with the other speaker on the screen. Just as in the Repeat-after-me Session, learners can record their voices and check the accuracy and naturalness of their performance. LP's three practice sessions thus work together to make learners' mastery of model dialogs as easy and effective as possible.

LP consists of two major components: a learner interface and a dialog library that contains video clips and dialog files. Video clips are digitized movie files, and dialog files are text files that contain a dialog text, its translation, and other information necessary for the interface operations. Dialog files are created by LP's authoring tool, LP Author, with sets of movie files as input.

Using LP Author, instructors can create their own dialog materials and add them to the dialog library, or they can modify existing dialog files. Because LP is language independent, it can be used for any language as long as the computer platform supports that language. LP runs on both PC and Mac platforms.

The development of LP is based on three major premises:

1. Activities that involve real communication promote learning (Richards and Rogers 1986).
2. Low personal anxiety and low classroom anxiety are more conducive to second language learning (Krashen 1982).
3. Mastering meaningful model dialogs with carefully focused functions promotes acquisition of communicative skills (Tsutsui, Kato, and Mohr 1998).

The objectives, design concept, and actual content of LP reflect these premises.

There are numerous benefits to using LP in language learning. By presenting pseudo-conversation partners on the computer screen, LP creates an air of reality in the learner's practice environment (whether in the language laboratory or at home) so that students can practice dialogs as if they were involved in real conversation. This type of practice environment not only provides strong motivation for learning but also allows students to acquire linguistic and nonlinguistic communication skills in an integrated fashion.

Furthermore, by allowing learners to do the simulated practice at their own pace, LP helps them build self-confidence and reduce personal anxiety when performing assigned dialogs in classrooms and eventually in real conversation settings.

Language learning with LP also enables instructors to redefine home, language lab, and class activities. With LP, instructors can expect a higher level of preparation from students before they come to class; therefore, instructors can use class time for advanced communicative activities (such as extension of model dialogs, role plays, and simu-
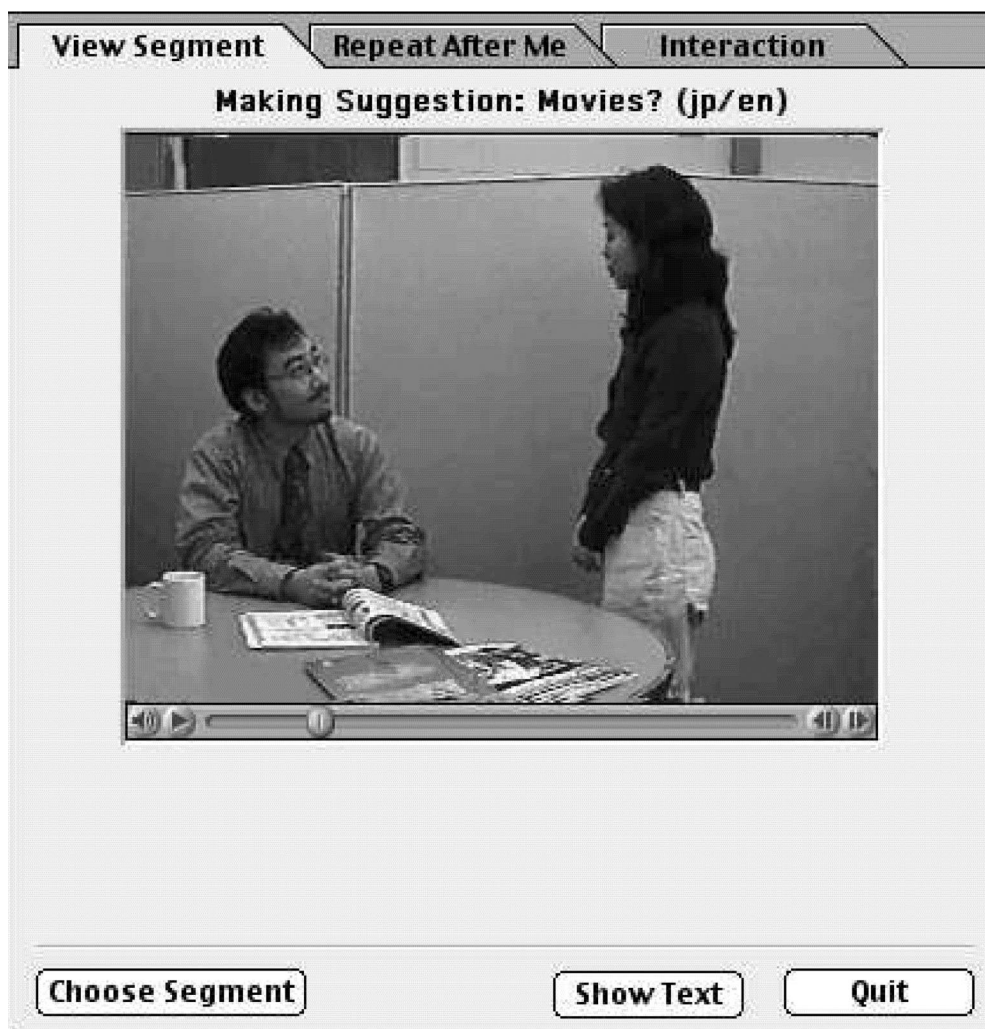
Figure 4. Language Partner's Preview Session.

lations), activities that are difficult for students to do on their own. Additionally, if video segments are provided for students through CD-ROM or broadband Internet connections, students can practice LP dialogs at home without being restricted by language lab hours.

As a language learning tool, unlike many other software programs, LP's open-ended structure gives instructors a high degree of expandability and flexibility. That is, because LP's dialog library is open ended, instructors can add dialogs to the library according to their instructional needs. LP is also flexible in that instructors can arrange the lessons of the dialog library in whatever way they like, and they can even modify the content of dialog files if necessary (such as changing the name of a speaker or changing the current translation language). This flexibility and ex-

pandability is impossible with conventional programs where the content and structure are predetermined.

Technical communicators are well suited to spearhead the development of instructional software with a language and communication focus. At present, LP is used in Japanese classes at the University of Washington and at several other universities in the U.S., and its effectiveness is recognized by instructors and students alike. The LP development team is currently working to integrate the program into Internet-based distance learning courses.

8. Supporting teaching and learning in the academy

Instructional design has always been at the core of technical communication. This core competency, coupled with
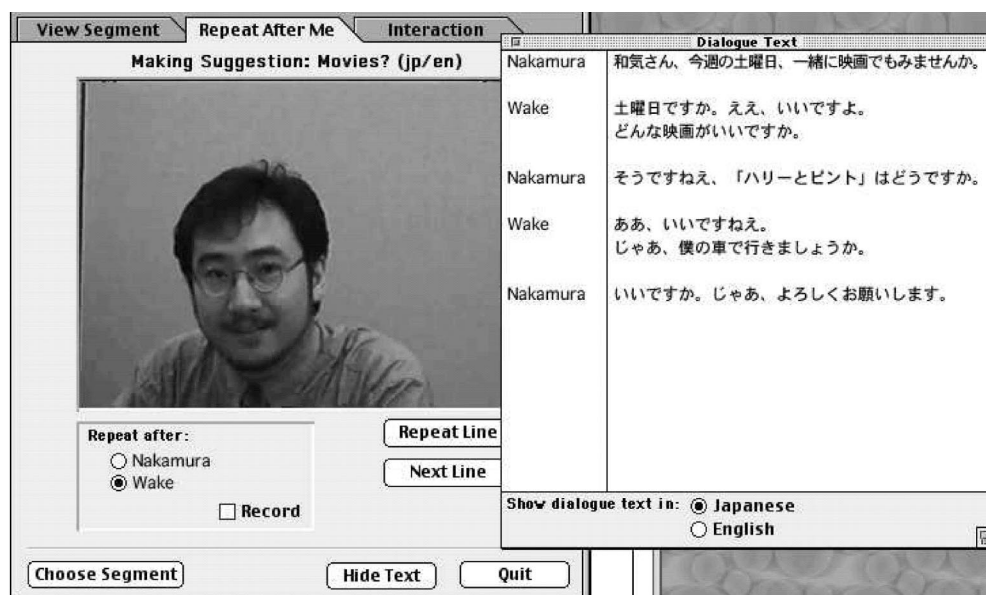
Figure 5. Language Partner's Repeat-after-me Session.

the fact that technical communicators are often called on to develop and administer service programs in technical writing, creates many opportunities for technical communication academics to contribute to the broader teaching mission of the academy.

One of these contributions is bound to be for ABET accreditation. ABET now requires that every accredited engineering program show student proficiency in 11 areas, including communication. Programs also must show that they have a process in place that assesses these proficiencies and that the results of the assessment process are fed back into curriculum and instruction.

At the University of Washington, the person chiefly responsible for developing learning outcomes for engineering writing as well as a process for assessing those outcomes has been the Director of the Engineering Communication Program, who, of course, is from UWTC. This 5-year project of developing learning outcomes and an assessment process is briefly described in the following paragraphs.

At the University of Washington, all engineering students are required to take an introductory technical writing course. In addition, many engineering departments require an advanced course in technical writing and oral presentation. In 1996, we began our 5-year journey with an investigation into the status quo.

We knew what students were learning in the stand-alone introductory and advanced technical writing courses, but we did not have a clear picture of the writing that students were doing in other parts of their engineering curriculum. So we determined that it was necessary to conduct a baseline investigation of the state of engineering writing across the college. Such an investigation began with research into writing assessment in general, and this research showed us that, in the larger field, writing assessment had moved from looking at writing in testing situations to looking at writing produced in more authentic contexts and, often, collected into various types of portfolios (Scott, Plumb, and Ramey 1997; Stewart, Choate, and Poteet 1995; White 1994; Witte and Faigley 1983).

The portfolios that we decided to compile consisted of a rich set of documents from a small sample of engineering students. The collection period was 2 years, the time students generally spend in the College of Engineering, and the portfolios consisted of the following items: all the writing students completed while in their engineering department, assignment descriptions for this writing (if available), videotapes from initial focus groups, entry and exit surveys, and reflective writing throughout the collection period.

From the portfolios, we learned that students' writing experience varied greatly from department to department, and that the concepts learned in the stand-alone technical writing courses were generally not reinforced in other courses. This finding is not surprising, but in conjunction with the new ABET process for accreditation, it convinced us that we needed to develop college-wide performance outcomes for engineering writing. These outcomes could provide more consistency for writing instruction across the college and possibly also help engineering faculty who

were assigning and assessing writing.

The outcomes were developed in the autumn of 1999 by a group of engineering faculty and students, and facilitated by the Director of the College of Engineering Communication Program and a representative from the University of Washington's Office of Educational Assessment. The group discussions that resulted in a list of specific learning outcomes for engineering writing were engaging and informative; in fact, many faculty commented on how the discussions helped them be more effective in designing and grading student writing.

We then used the performance outcomes to conduct a baseline outcomes assessment of engineering writing in the college. A random sample of senior-level papers from each department was evaluated using a rubric developed from the list of outcomes.

From this assessment, we discovered several specific areas of weakness in student writing. For example, students across the college had problems with effective use of source material. The coverage of this topic will be enhanced in the stand-alone technical writing courses.

This assessment process will be ongoing, and we will evaluate a sample of student writing from half of the engineering departments each year. A full description of the process, including the performance outcomes developed in autumn of 1999, can be found elsewhere (Plumb and Scott 2002).

The expertise gained from this experience has enabled the director to contribute to other groups going through accreditation or assessment processes, including engineering schools at other universities and faculty in other fields at the UW. The natural trajectory of this work is an even broader contribution by UWTC faculty to undergraduate education in both assessment and faculty development.

CONCLUSION

This article has described eight current projects where technical communicators are working in areas that extend our field beyond the traditional focus on technical writing, editing, and production. Certainly there are many other projects across the country and world that are further expanding our field through scholarship, research, and development. It is equally certain that such projects go beyond and yet also inform the day-to-day practice of technical communication.

Not only does examining current research and development projects help to clarify the expanding boundaries of our field, but it also demonstrates that technical communicators are adding critical value to activities spanning many related fields and covering the full range of endeavors involving information, communication, and supporting technology. This value stems in part from our unique focus on the human-centered aspects of these endeavors and can therefore be seen as an expansion of the value that technical communicators have been adding for decades to more traditional areas of technical writing, editing, and production. T**C**

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