December 15, 2000

Dick McCormick
President
University of Washington

Dear Dick:

It is with great pleasure that we submit to you our first year report on behalf of the twenty individuals who are members of the Program for Educational Transformation Through Technology.

In this covering letter we provide some bulleted talking points regarding the program. These points could be used to explain to the campus community some of the activities that have been taking place as a result of PETTT.

The report itself begins with an executive summary and then a program overview. The body of the report discusses the scientific approach and then discusses specific elements of the research and development program in some detail, documenting accomplishments that can be mapped to the memorandum of understanding that we submitted almost one year ago.

We would like to thank the University of Washington for this truly unique and special opportunity to learn about and contribute to the process of education.

Best wishes,

Frederick A. Matsen, Principal Investigator

Scott Macklin, Program Director

PETTT Talking Points

The Program for Educational Transformation Through Technology is a University Initiative Fund program of the University of Washington. Its mission can be stated as follows: "To employ modern technology to help teachers to teach, to help learners to learn, and to help the University of Washington disseminate its knowledge broadly across the state, region, nation, and world."

In its first nine months, PETTT has:

• brought together previously dispersed interests and expertise into an integrated and functioning team of scientists, teachers, students, and technology experts dedicated to a common mission. The synergy from the bringing together of this interdisciplinary team has fueled the pace of the PETTT accomplishments.

• carried out scientifically rigorous research that is being prepared for publication and has been presented in national peer forums. Our focus has been not only on the design and implementation of technology, but on measuring the effectiveness with which technology can help accomplish educational objectives and learning from these attempts.

• pioneered what is rapidly becoming a national movement to couple the evolution of educational technology with the evolution of pedagogical approaches – recognizing that each of these can, and should, influence the other.

• identified and enacted research methods that provide crucial insights about how specific technologies can augment teaching and learning in the context of each of the exemplar projects: the Arthritis Source Project and Computer Science & Engineering Tutored Video Instruction (TVI) Pilot Project. Such methodologies will be shared with the broader University of Washington community so others can gain familiarity with the benefits of these approaches for the specific issues they face as educators.

• leveraged and amplified resources existing on our campus. The existing richness of University of Washington programs such as UWired; Computing and Communications; the Center for Teaching, Learning, and Technology; the Center for Engineering Learning and Teaching; the Office of Educational Partnerships; the College of Education; and the School of Library and Information Sciences along with the strengths of Departments such as Computer Science and Engineering and Orthopaedics and Sports Medicine have enabled PETTT to accelerate its programmatic development.

• enabled the University of Washington to take a lead in the development and assessment of educational strategies and tools. Such a leadership role is expected of a large research University located in a center of technological development.

• become a broadband program of general relevance to teaching and learning on the University of Washington campus and beyond. PETTT has focused on strategies and technologies that have general applicability and that can be scaled to accommodate the depth and breadth of the University's educational mission.

• disseminated its work through public education forums, the World Wide Web, publications and presentations, and meetings with interested departments and faculty. Our goal is to encourage teachers and learners to adopt the strategies and technologies and to critically assess their effectiveness throughout the full range of the University's scholarly activity.

PETTT

ANNUAL REPORT

The Program for Educational Transformation through Technology (PETTT) is a UIF funded initiative at the University of Washington. We would like to thank our collaborating partners, which include: College of Education, College of Engineering, Computer Science & Engineering, College of Forest Resources, Office of Educational Partnerships, and the School of Medicine Department of Orthopaedics and Sports Medicine.

For more information about PETTT, please see: http://depts.washington.edu/pettt/

The University Initiatives Fund (UIF) is a mechanism for reallocating resources. Its goal is to fund innovative new programs, strategically selected to strengthen the University of Washington and to seize opportunities that would otherwise be lost. The UIF was introduced by President McCormick in January 1996 after wide consultation with faculty and administrators.

For more information about the UIF, please see: http://www.washington.edu/uif/

EXECUTIVE SUMMARY

A primary goal of PETTT is to enhance the effectiveness of teaching and learning at the University of Washington by promoting effective uses of technology. The basic premise of PETTT is that modern technology can enable the development of new educational strategies that transform the way in which teachers teach and learners learn and can facilitate the dissemination of the educational programs of the University of Washington. A unique feature of PETTT is that our efforts to enhance local teaching and learning are coupled with a commitment to world-class research. We have anchored our research efforts in exemplar projects in order to promote this close connection between research and educational enhancement.

At the inception of the PETTT program, our focus centered around three principal issues:

1. While many faculty wish to utilize technology in education, the effort necessary to integrate technology into educational practice is often prohibitive. This effort involves addressing both technical issues and issues about how to change pedagogical practices in order to incorporate new technologies.

2. While many educational initiatives using technology have been launched, there is little information available concerning the effectiveness of these efforts, and the impact of technology and pedagogy on one another has been minimal.

3. While there is a broad demand for access to the educational programs of the University of Washington, the use of technology to disseminate these programs is in its infancy.

Our PETTT approach is to address the above issues through research and development efforts carried out in the context of exemplar projects. We do this because we believe that technology, pedagogy, and their interplay must be evolved and evaluated in real settings. Our two exemplar projects during this first year have been the Arthritis Source and the Computer Science and Engineering (CSE) Tutored Video Instruction Pilot (TVI) projects, representing informational Web sites and multimedia-enhanced distance education, respectively. From our exemplar-motivated research, PETTT will generate general principles for working with these and similar educational technologies, initiate conversations among educators about their experiences with the technologies, and drive the exemplars themselves to refine their tools and practices. Over time, PETTT will add exemplar projects to address other learning domains, instructional strategies, and mediating technologies – such exemplar research may lead to a richer understanding of the quality and extent of learning that takes place within environments such as online communities, collaborative virtual spaces, or interactive simulations. PETTT's identification of future exemplars will be influenced by mapping out innovative uses of educational technologies at the University of Washington and building on a network of conversations with faculty about their experiences using technology. Our efforts are briefly summarized here, and explained in further detail in the body of this report.

Helping teachers to teach: Through our exemplar-based research, we have identified several effective and easy-to-implement ways in which technology can uniquely assist faculty in their educational missions. By working with the Arthritis Source exemplar, we have developed a simple format for educational materials that can be disseminated on the web, in the classroom, and in the form of informational brochures. This format treats different components of the materials as elements of a database, which facilitates indexing, editing, and access using a wide variety of devices, such as personal digital assistants, personal computers, and soon digital phones. By working with the CSE-TVI pilot project, we have identified specific uses of video technology that promote learning and productive interactions between students and teachers, and have also uncovered specific impediments to learning that were not otherwise obvious to the instructors. As a result, we have created recommendations for training small group facilitators who work with tutored video instruction and for redesigning video-based instructional materials. Coupled together, these recommendations can improve the effectiveness of teaching with video, and thus enable faculty members to broadly disseminate their teaching effort. Because we anticipate that these two models for teaching with technology are scalable and generalizable, we plan to package them as elements of the 'educational toolbox' represented by the Catalyst Web site.

Helping learners to learn: Assessing the effectiveness of Web-based education is challenging and important, especially as more faculty begin to put educational content on the Web. Faculty members are often uninformed about the extent to which their sites are useful and are unaware of ways in which they can be made more effective for learners. Because of the importance of learner evaluation of and feedback about educational sites, we have developed the concept of Site Value Analysis - a hierarchy of evaluation methods that can be applied to any educational Web site. These methods can be described in order of increasing involvement of the learner. At the lowest level are automated tools that can be implemented without any involvement of the learner - hit rate, path analysis, and search engine ranking. At the next level is our Simple Utility Tool (an online polling tool), which enables learners to grade Web pages in terms of their usefulness by clicking among options. At the next highest level, on-page email responses can be used to gather rich information about the needs of learners. Still higher in the hierarchy are methods, which require the extensive involvement of learners, such as online surveys.

We are currently using versions of each of these approaches to better understand the extent to which the Arthritis Source is currently effective, and how it may be adapted to be more effective in the future. For example, we have used an on-line survey to characterize learners and their learning needs in order to inform site content and design. We have also collected questions from users through on-page email responses and are developing methods for systematically analyzing and categorizing such data in order to better understand how the site can be optimized to meet the needs of learners. In the upcoming year, we will tackle the highest level on the Site Value Analysis hierarchy— rigorously assessing the acquisition of knowledge by learners and beneficial changes in learner behavior.

Using these and other research strategies, we intend to continue to conduct careful research to better understand the needs of learners, and to use this information to iterate on the content, form, and use of technologies. We have emphasized the importance of understanding the context within which a technology is implemented, and are striving to close the vital feedback loop between learner and the teacher.

Dissemination of knowledge: Achieving the full potential of technological dissemination of knowledge across the breadth of our campus involves more than simply developing new tools. One of our overarching dissemination goals is to fuel the creativity and nourish the inventiveness that are so strongly represented in the UW faculty. Because we recognize that the intentions, interests, motivations, experience, and learning styles of UW faculty are diverse, we have employed a number of mechanisms for "spreading the word" about educational uses of technology.

1. Engaging individual faculty in the creative application of new educational strategies in their teaching programs by creating opportunities in which faculty and students learn to innovate from one other, as colleagues, as peers, and as a community of lifelong teachers and learners.

2. Creating and popularizing flexible, generalizable, and scalable tools and strategies that can easily be adapted to different educational content, to different styles of education, and to new educational domains.

3. Helping faculty to develop an understanding of when specific uses of technology can uniquely promote student learning and how they can assess the efficacy of their efforts.

A highlight of PETTT's first year was the delivery of a campus-wide symposium – a "Spring Fling" – featuring two nationally renowned researchers: Dr. Roy Pea and Dr. Judy Ramey. PETTT has also sponsored other forums for faculty to learn about educational technology issues, including two visits by commercial technology groups and five WebEd meetings in which faculty members share their experiences using technology.

We are currently laying the groundwork to disseminate PETTT findings through Catalyst. Based on our research activities, we have identified four "guides" to help faculty use our strategies to evaluate their own educational technologies. We are also planning to develop resources that will help faculty in other disciplines effectively implement the instructional approaches represented by TVI and the Arthritis Source.

Based on our scholarly research with the two exemplars, we have prepared a paper to be submitted to the journal *Educational Technology Research and Development*, have submitted ann abstract for a presentation at the American Education Research Association national conference, and have given a presentation at the Mary Gates Research Symposium.

Finally, PETTT has been mentioned in over 10 presentations at conferences, professional groups, and university organizations. This exposure has helped us spread the word to the broader academic community. PETTT has also supported and informed the Catalyst rollout strategy, which includes over 16 "road-shows" each September to different departments across the University of Washington, including the Bothell and Tacoma campuses.

PROGRAM OVERVIEW

In this section, we seek to emphasize the achievements which would not have happened during this year at the University of Washington had PETTT not received funding.

The core of PETTT's first year has been research carried out in the context of existing educational technologies and programs (exemplars). During the first year, we have focused on two very different exemplars – the Arthritis Source and the Computer Science & Engineering (CSE) Tutored Video Instruction Pilot Project. The Arthritis Source is a web-based information resource that provides information about arthritis to interested learners at large (i.e., learners external to a defined curriculum). Tutored Video Instruction (TVI) is an instructional approach combining elements of on-demand lecture videos, small group discussion, and tutoring. The CSE department has used this approach to disseminate its introductory computer science courses to students at community colleges. One role of PETTT is to extend the reach of these exemplars by creating structures, which allow others to employ similar educational approaches more easily. Improving the effectiveness of these instructional approaches will encourage teachers to incorporate them into their educational practices, and will increase the gains made by learners.

We have devoted much of the first year to developing a PETTT approach. This approach involves the use of exemplars as test-beds for research on the science of learning and as models for adaptation, generalization, and scaling of educational technologies. Our approach takes exemplar projects through a series of three steps:

1. Characterize the exemplar: Define the critical attributes of the exemplar, seeking to determine which domains of educational practice the exemplar represents.

2. Conduct research with the exemplar: Use the above characterization as the foundation for framing and executing research on the critical elements of teaching and learning with the exemplar.

3. Refine the tools and practices represented by the exemplar: Use the above research to inform the improvement of the exemplar's form, content, and uses by its owner.

In practice, steps 1-3 may involve several concurrent cycles as we evaluate different versions of the exemplar while simultaneously studying issues related to a variety exemplar-related issues. At various points in this process, we may pause to perform a variety of "spin-off" activities. We may document the elements of the exemplar and its uses, and provide a description of its implementation to other faculty. We may develop tools and guides for dissemination to the faculty at large. In order to help faculty use these tools for different pedagogical purposes, we may highlight possible differences in approach that become apparent as various faculty make use of these resources in different contexts. We may also present the results of our investigations at local and national meetings and in scholarly publications.

The application of the PETTT investigative approach to the Arthritis Source exemplar

The Arthritis Source, implemented by the UW Department of Orthopaedics and Sports Medicine, provides learners at large with access to useful and reliable information about the many forms of arthritis and strategies for living with this lifelong disease. These learners may include individuals with the condition, family members, students of the health sciences, or the public in general. Following the PETTT approach, we have taken the Arthritis Source through these steps:

1. Characterize the exemplar: We have described the Arthritis Source as an example of a system for disseminating on-demand, authoritative information to learners at large in such a way that the learners can provide feedback to the content creators regarding the type and form of information needed to serve their particular purposes.

2. Conduct research with the exemplar: The above characterization led to a critical analysis of the existing Arthritis Source. This analysis pointed to the need to better understand how learners at large locate the Source, how the content can best be formatted, and how feedback from learners can be captured in a way that informs the iterative improvement of the site.

3. Refine the tools and practices represented by the exemplar: The owner of the Arthritis Source exemplar, Rick Matsen, has stated, "having the energies and expertise of PETTT focused on the Arthritis Source has revolutionized my understanding of the process of information transfer." The interaction between PETTT and the Source has highlighted the necessity of dynamic relationships among content, content providers, content users, and tools for evaluating site effectiveness. We have come to recognize that specific steps must be taken to assure that Web-based educational resources are findable, particularly if those resources are designed primarily for learners at large. As a result, we are currently restructuring the Source into an XML-based format so that the elements of the Source can be readily found, accessed, and tailored to the needs of individual learners. We have further determined that learner feedback is essential to the creation and iterative enhancement of site content. As a result, we are currently in the process of implementing Site Value Analysis (SVA) systems through which learners can become teachers regarding the form and substance of the Arthritis Source.

The lessons we have extracted from the Arthritis Source are generalizable to many situations in which education takes place outside the confines of a highly structured course. Because we believe that the Source approach is applicable to a variety of other educational contexts, we plan to assemble the lessons learned into a documented Source tool that faculty in other disciplines can use to implement their own Source. We also believe that our methods for evaluating the effectiveness of educational Web sites are likely to be useful to other faculty. As a result, we have developed the concept of Site Value Analysis – a hierarchy of methods that can be applied to any educational Web site in order to get feedback on the site's effectiveness. We plan to assemble our SVA approach into a set of resources that faculty can use to evaluate the effectiveness of their own Web sites. In addition, we will submit the results of PETTT research on helping learners at large find resources for publication in *Educational Technology Research and Development*.

The application of the PETTT investigative approach to the Computer Science & Engineering Tutored Video Instruction Pilot exemplar

In the CSE –TVI pilot project, Tutored Video Instruction (TVI) is being been utilized by the UW Department of Computer Science and Engineering (CSE) as a way to reduce redundant educational effort, to increase the quality of introductory programming courses statewide, and to allow other institutions to offer courses even if qualified instructors are not available. Following the PETTT approach, we have taken the exemplar through these steps:

1. Characterize the exemplar: We have described The CSE TVI Pilot as an example of a system for disseminating pre-prepared video-based instructional materials to learners who interact with the materials in small groups guided by informed facilitators.

2. Conduct research with the exemplar: The above characterization led to a critical analysis of the TVI Pilot Project. This analysis revealed ways in which the video production of lecture (a key element of the approach) could be improved - by compressing viewing time by one third, giving the program a longer lifetime, and eliminating irrelevant elements that were an unavoidable part of the original "let the camera roll from the start of the lecture to its end" approach. We also discovered that instructor level of CSE teaching experience and training in the use of TVI are essential issues to consider in achieving an effective TVI implementation.

3. Refine the tools and practices represented by the exemplar: Ed Lazowska, the owner of the TVI exemplar, has stated that, "the PETTT analysis has contributed enormously to my understanding of TVI." The CSE Department plans to substantially modify the TVI program for this fall based on PETTT input.

Because we believe that TVI may be a widely applicable instructional paradigm, we plan to assemble the lessons learned into a documented TVI tool , which can be used by faculty in other disciplines who wish to implement TVI. In addition, we have submitted an abstract regarding the PETTT experience with TVI to the American Educational Research Association (AERA) 2001 annual conference.

PETTT dissemination efforts

We have made initial design recommendations to the owners of both PETTT exemplar projects in order to improve the quality of educational materials available to individuals who otherwise would not have had access to these resources. In the upcoming year, students at several community colleges will learn introductory computer science via an improved version of TVI. Also during the upcoming year, arthritis learners at large will gain access to a restructured Arthritis Source containing more easily comprehensible information, as well as improved access to this information.

We have sought to enlist the active participation of individual faculty as well as the leadership of C&C, UWTV, the School of Library and Information Science, the Health Sciences Center for Educational Resources, University Libraries, and other UIF programs like the Program in Biomedical and Health Informatics in order to leverage and amplify resources existing on campus.

We have used a wide variety of methods to “spread the word” about PETTT. Dissemination activities include working with the Center for Teaching, Learning, and Technology to further develop the Catalyst suite of educational tools and teaching with technology guides, publications, forums, and presentations. PETTT has been the focus of seven presentations, including both national and international presentations, and mentioned in several others. Scott Macklin's and Mark Donovan's article, "The Catalyst Project: Supporting Faculty Uses of the Web . . . with the Web," received the 2000 *EDUCAUSE Quarterly* Contribution of the Year Award. The University of Washington also won EDUCAUSE's inaugural Award for Systemic Progress in Teaching and Learning. This award recognizes replicable, scalable, and transformational programs that have helped move institutions toward enterprise-wide instructional systems.

One of the highlights of PETTT's first year was the execution of a campus-wide symposium - a “Spring Fling” featuring two nationally renowned researchers, Dr. Roy Pea and Dr. Judy Ramey, who spoke about issues related to education and technology. This symposium brought together participants from twenty different academic departments and disciplines. A recorded version of the symposium has been rebroadcast over UWTV and has become part of the content of the UW Research Channel. Other efforts to support the local UW community include supporting the WebEd discussion forum, organizing campus-wide presentations by commercial educational technology vendors, and presenting PETTT activities to departments and units around campus.

READER'S GUIDE

In this report, we describe PETTT's accomplishments during our first year of funding. Because the body of the report contains a large amount of information, we have provided the following reader's guide to help interested readers identify relevant sections of the report:

- Defining a PETTT framework (What we do): Defining a framework for activity represents an important conceptual milestone for the first year of activity. In Section I of this report, we describe the framework for PETTT activities that relates our overall mission to our three-pronged strategy of working with exemplar projects, focusing on dissemination, and undergoing continuous external evaluation.

- Program operations (How we manage it): Setting up program operations is an important milestone for a new program, particularly during the first year. In Section II of this report we focus on the program operations of PETTT during the first year, including hiring and the first year timeline.

- Conducting research in the context of exemplar projects (Details): A key feature of the PETTT approach is the employment of exemplars – existing uses of technology to support UW educational efforts – as test-beds for research and development activity. In Sections III and IV of this report, we describe our work with the Arthritis Source project and the Computer Science & Engineering Tutored Video Instruction project, respectively.

- Disseminating knowledge about technology for education (How we share): A second key feature of the overall PETTT approach is to employ a variety of strategies for disseminating knowledge about how information technology can be used to support teaching and learning. In Section V of this report, we provide a comprehensive description of our dissemination efforts, some of which stem directly our research and some of which are more general strategies.

- Program evaluation (How we're doing): A final key feature of the overall PETTT approach is a commitment to continuous external evaluation of our efforts to ensure that we are succeeding in accomplishing our goals. The final section of the report, Section VI, contains observations from an evaluator charged with keeping the program on track.

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SECTION I. PETTT FRAMEWORK (WHAT WE DO)

PETTT's Mission: To employ modern technology to help teachers to teach, to help learners to learn, and to help the University of Washington disseminate its knowledge broadly across the state, region, nation and world.

The basic premise of PETTT is that modern technology can transform education by enabling the development of new educational strategies, and the improvement of existing strategies. PETTT's primary goal is to catalyze this transformation by (1) **conducting research** on how modern technology can be used to help teachers teach and learners learn more effectively; and (2) **promoting effective educational uses of technology** at the University of Washington.

We have spent much of our first year developing a PETTT framework for achieving these goals. This undertaking represents a significant Year 1 conceptual milestone. Our framework has been influenced by Rogers' ideas about factors that promote the diffusion of innovation on a university campus. Rogers (1995) suggests that easily diffused innovations are those that (1) convey a relative advantage over existing ways of doing things; (2) are compatible with the expectations, experience and needs of faculty; (3) reduce the complexity associated with new technologies; (4) support experimentation on a limited basis; and (5) are widely observable to the campus community.

Our PETTT framework has emerged as an action plan to address the coupled goals of research and educational enhancement, while recognizing the important elements of diffusing innovation. Our framework is based on three key elements:

1. Research: Conduct research in the context of exemplar projects.

2. Dissemination: Promote educational enhancement by using continuous and diverse approaches to disseminating knowledge about using technology for teaching and learning.

3. Continuous evaluation: Continuously evaluate our program in order to ensure that it plays a role in catalyzing the transformation of education through the effective use of technology.

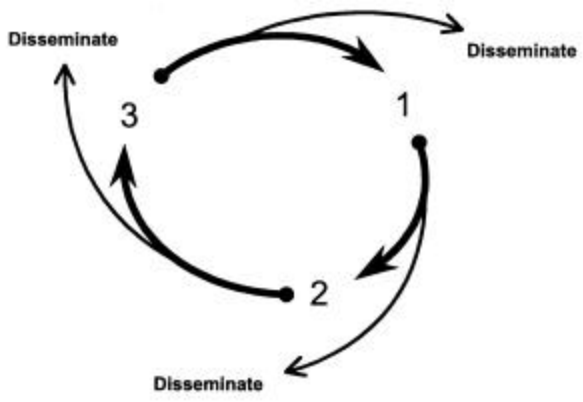
Exemplar-Based Research

The first element of the PETTT framework is a commitment to conducting research in the context of exemplar projects, where any existing use of technology to support an educational mission of the University represents a potential PETTT exemplar. While situating our research in the context of exemplar projects may have some drawbacks, we believe that these drawbacks are outweighed by the many benefits of conducting research in this context. By working with exemplars, we can avoid the often lengthy period associated with the initial design and debugging of new technologies. Moreover, because they are developed by UW educators, exemplars embody the constraints and considerations of UW educational activities and the real-world "messiness" of true educational activity.

In the PETTT framework, exemplars become test-beds for research, which proceeds following these steps:

1) Characterize the exemplar: The first stage of our research is to identify the critical attributes of each exemplar in terms of learners, learning domains, instructional approaches, structure of the learning environment, and characteristics of the technology. This characterization emerges from our initial interactions with the exemplar and its designer, and is refined as a result of the research efforts conducted in the next phase of the cycle. Ultimately, our goal is to choose a set of exemplars, which reflect the wide range of learners, learning environments, and educational content associated with the University's educational mission.

2) Conduct research with the exemplar: Based on our characterization of an exemplar, we identify and conduct research activities related to its effectiveness as a tool for teaching and learning. One important aspect of this research is rigorous evaluation of the exemplar's effectiveness in fostering learning. Another focus may be the extent to which an exemplar is already consistent with Rogers' (1995) criteria for technology diffusion and the ways in which it can be made more consistent with these criteria. Other research themes may include the developing and using mechanisms for learner-centered evaluation, studying the critical elements of exemplars, and studying ways in which the same educational technologies are used in different contexts and for different pedagogical purposes. Our research is based on actual learner use of the system as much as possible, because we believe that technology, pedagogy, and their interplay evolve and must be evaluated in real settings.



3) Refine the tools and practices represented by the exemplar: A key element of our research cycle is to use our results to inform the improvement of an exemplar's form, content, and uses. The refinement of an exemplar may then be followed by another iteration of rigorous evaluation.

In practice, steps 1-3 may involve several concurrent cycles as we evaluate different versions of the exemplar while simultaneously studying issues related to a variety exemplar-related issues. At various points in this process, we may pause to perform a variety of "spin-off" activities. We may document the elements of the exemplar and its uses, and provide a description of its implementation to other faculty. We may develop tools and guides for dissemination to the faculty at large. In order to help faculty use these tools for different pedagogical purposes, we may highlight possible differences in approach that become apparent as various faculty make use of these resources in different contexts. We may also present the results of our investigations at local and national meetings and in scholarly publications.

Development and Dissemination

PETTT's goal of catalyzing the transformation of education through the effective use of technology cannot be accomplished solely through research; ultimately such transformation will occur through the efforts of UW educators. Thus, a second key element of our overall framework is a focus on dissemination of processes, tools, and ideas. In order to facilitate the dissemination process, we have created opportunities for educators to learn to innovate both by using PETTT resources, and by learning about one another's experiences as colleagues, as peers, and as a community of lifelong teachers and learners.

We have chosen to disseminate knowledge about educational technologies via a variety of avenues so that we can reach as many educators as possible. To date, we have identified six dissemination strategies. The first three follow from our exemplar research efforts and are focused on ensuring that we conduct "research that matters" (Sabelli, 2000). The remaining three strategies are more general, and complement our exemplar research efforts.

1. Improve the exemplars: PETTT can disseminate knowledge by using research results to improve and refine the exemplar projects. Each iteration of exemplars embodies (disseminates) the lessons that we have learned from the previous iteration.

2. Add tools, techniques, and ideas to the 'educator's toolbox': As we progress through the research process with an exemplar, we strive to translate what is learned into guides and tools are of broad use to UW faculty. We work closely with the UW program Catalyst to develop and disseminate these guides and tools.

3. Publish and present in scholarly communities. Since PETTT is a university-based research endeavor, it is important that we participate in scholarly dialogue and contribute to the creation of new knowledge our research area. Thus, we also disseminate the knowledge that we develop through traditional avenues of scholarly publications and presentations.

4. Make our process visible: While the preceding dissemination efforts focus on us disseminating the results of our research, we also believe that the process through which we study the exemplars has educational value. We make our own process visible through avenues such as public presentations and our Web site so that others can learn from our process.

5. Create and nurture communities on the UW campus: Because UW faculty may learn about educational technology not only through PETTT efforts, but also from one another, we create and nurture communities on the UW campus in which such learning (and thus dissemination of knowledge) can take place. Our efforts to do this range from facilitating small discussion groups, such as WebEd, to larger campus-wide forums involving famous guest speakers.

6. Bring lessons learned to new domains (via new exemplar projects): A final form of dissemination is to translate lessons learned in one domain into new domains through new exemplar projects, bringing us full circle.

Ongoing Evaluation

The final element of our overall PETTT framework is a commitment to continuous evaluation comparing the functioning and outcomes of our program to our stated objectives. Such an evaluation provides a broad overview with two goals: first, to provide program leadership with regular feedback regarding the conduct and direction of the program (we specifically wish to avoid what some have termed ”mission creep”); and second, to inform both program leadership and the University community about PETTT success in achieving its mission.

SECTION II. PROGRAM OPERATIONS (HOW WE MANAGE IT)

Setting up program operations is an important milestone for a new program, particularly during the first year. In this section, we focus on the program operations of PETTT during the first year, including hiring and the first year timeline.

Budget

PETTT's 1999-2001 University Initiatives Fund Allocation is shown in the table below. PETTT has requested a carry-forward on budget 59-1501 in the amount of $524,000. Due to the time it took to hire qualified staff, we completed our hiring process July 2000. Now that we are fully staffed, the program is proceeding as anticipated. For that reason it is essential that we retain our allocation.

	1999-2000 (actual)	2000-2001 (projected)	1999-2001 Total	Requested Carry-forward
Budget Allocation	633,796	633,796	1,267,592	
Expenditures	192,751	550,523	743,274	524,318

Leadership and Organization

Our Executive Committee provides program leadership to PETTT. This committee consists of Frederick A. Matsen III (Orthopaedics), Louis Fox (Office of Educational Partnerships), Ed Lazowska (Computer Science & Engineering), and Denice Denton (Engineering).

Professors Cindy Atman (Center for Engineering Learning and Teaching (CELT) and Industrial Engineering), Philip Bell (College of Education), and Reed Stevens (College of Education) provide leadership in issues related to the science of learning and evaluating the educational effectiveness of technology.

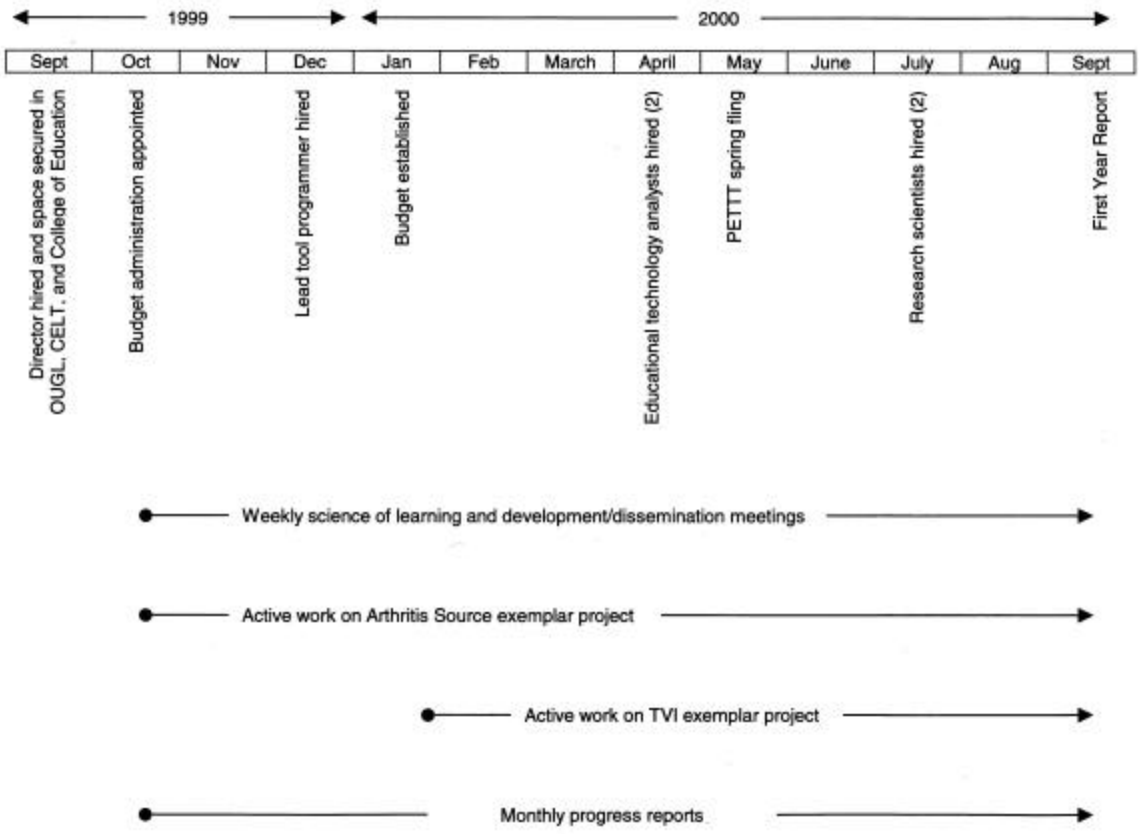
Research, development, and dissemination are the responsibility of the project team. This team is listed below, along with each member's date of hire:

Scott Macklin, Program Director (fall '99, located in OUGL)
Jennifer Turns, Lead Research Scientist (summer '00, located in CELT)
Gina Cherry, Research Scientist (summer '00, located in College of Education)
Kurt Kors, Educational Technology Analyst (spring '00, located in OUGL)
Tracey Wagner, Educational Technology Analyst (spring '00, located in CELT)
Ralph Warren, Educational Technology Analyst (summer '00, located in HSCER)
Trevor Leffler, Lead Programmer (winter '99, located in OUGL)

Nana Lowell, Associate Director of the Office of Educational Assessment, is responsible for continuous program evaluation of PETTT.

Time Line Sept 1999 – Sept 2000

The timeline below highlights several first year PETTT milestones, such as when various personnel joined the program. Establishing on-going meetings was an essential aspect of our start-up process. These meetings create channels of communication , which allow the variety of people contributing to PETTT activities to coordinate their efforts. The timeline shows that despite a delay in establishing our budget, we were able to begin significant work activity as early as September 1999. Finally, the creation of monthly evaluation reports highlights our efforts to integrate program evaluation into PETTT from the very beginning.



SECTION III. EXEMPLAR 1 – ARTHRITIS SOURCE (DETAILS)

Having the energies and expertise of PETTT focused on the Arthritis Source revolutionized my understanding of the process of information transfer. The interaction of PETTT and the Arthritis Source pointed out the necessary dynamic relationships among content, content providers, content users, and tools for evaluation of effectiveness. I now see that learner feedback is essential to motivate the creation and iterative enhancement of content.
- Rick Matsen, Professor and Chair of Orthopaedics and Sports Medicine

How do I thank you for your well written article about Arthritis and Pregnancy? I always wondered why I have not been able to carry a baby past the first to 2nd month, but have always miscarried. Recently, it has been found that my sister and now my brother have Cardiolipin Antibody disease. ……. I have always wondered and tried searching for answers. Thank goodness for the internet.! Please I beg of you on behalf of all people, keep giving us information about this and other diseases so that we can find it and search it out so that we can be knowledgeable, so we won't be scared.
- Anonymous User of Arthritis Source

The Arthritis Source is a web-based information resource that was developed to help self-motivated, geographically dispersed learners ("learners at large") gain access to information about arthritis. Dr. Rick Matsen, Chair of Orthopedics at the UW Medical Center, first developed the Arthritis Source in 1995. Dr. Matsen is motivated by a desire to make high quality arthritis information available to patients and other interested parties across the state of Washington and around the world. Arthritis is now the most common cause of disability in the United States, and affects over 600,000 individuals in Washington State alone. The Arthritis Source has significantly contributed to reaching Dr. Matsen's goal of effectively disseminating information about arthritis, as reflected by emails from satisfied users, a large hit rate, and recognition from the Arthritis Foundation.

PETTT has collaborated closely with Dr. Matsen to evaluate and improve the Arthritis Source. We have conducted several different studies to evaluate the exemplar, and have made recommendations for its redesign based on these studies. PETTT personnel have worked closely with Dr. Matsen, and the exemplar technical manager, Aaron Louie, to create a structure for a redesigned site.

Activity 1: Characterize Exemplar

The Arthritis Source has a number of characteristics that make it an interesting and valuable PETTT exemplar. Several of these characteristics, described in terms of learners, learning domain, instructional approach, learning environment and learning technology, are listed in Table 1. Many of these dimensions were identified through two initial PETTT Arthritis Source activities: (1) In order to characterize the site and better understand its structure, we used Visio software to create a graphical depiction of the Arthritis Source components. and (2) We conducted a videotaped interview with the site designer, Dr. Rick Matsen. This interview provided insight into the assumptions about the users/learners which are embodied in the site's design, and into the design rationale underlying the design of original version of the site.

Table 1. **Characterizing the Arthritis Source Exemplar**

Learners o Non-traditional learners (learners at large). People interested in information about arthritis tend to be distinct in a variety of ways from many other learners associated with universities. For example, arthritis patients often live in isolated rural settings, many are of American Native ethnicity, and many are essentially housebound by their physical limitations. o Patients with chronic, progressive medical condition. Arthritis is a lifelong (chronic), variably progressive condition. Patients need an on-going source of information, but need different types of information at different points in their experience with arthritis. o Multiple learner populations sharing information sources. Arthritis is a subject about which different people, such as patients, relatives, and practitioners, need different perspectives on information.
Learning Domain o A constantly changing knowledge domain. The body of knowledge about arthritis is constantly changing because of on-going research about the condition. Because arthritis learners deserve to have the most up-to-date knowledge, it is important to determine how to keep the educational tool up-to-date. o Enabling multiple distributed authors to contribute content (distributed teachers at large). Keeping an information source like the Arthritis Source up-to-date is a significant challenge. Part of the design challenge with the Arthritis Source is to develop an architecture that enables the content development to be distributed yet easily synthesized.
Instructional Approach o Information therapy. The Arthritis Source represents an approach to medical treatment called information therapy. Knowledge about using the Arthritis Source to support information therapy could be extended to a variety of other medical conditions that may be treatable using this approach.
Structure of Learning Environment o Varied contexts. Learning materials are accessed in a variety of settings including home, doctors' offices, and work (limited only by access to the Internet). o Individual or group. Learning materials may be accessed by individuals or by groups (e.g., a patient working with family/friends/caregivers, a doctor working with a patient, etc.).
Characteristics of Learning Technology o Web interface to a multimedia database of information. The Arthritis Source is a web-based educational resource presenting multimedia information.

The Arthritis Source addresses the University's goal of educational outreach by reaching a large population of learners outside the traditional classroom context. This learner population includes patients, relatives, and health care providers, all of whom need different perspectives on the information. Because arthritis is a chronic, progressive condition, the information needs of these learners change over time. The Arthritis Source also represents an approach to medical treatment called "information therapy" - researchers have found that educating patients about their condition has a positive clinical effect. Finally, the Arthritis Source is an example of allowing multiple distributed authors to contribute content to a web site. Other members of the UW community whose teaching mission includes one or more of these characteristics may be interested in the research conducted with the Arthritis Source.

Activity 2: Conduct Exemplar-Motivated Research Based on the Characterization

In our work with the Arthritis Source, we have been focused on research questions in two primary areas:

- How effective is the Arthritis Source? What are some strategies for evaluating the effectiveness of an educational Web site at different levels, employing various levels of resources and effort?

- Who are the learners, and what are their learning needs related to arthritis? How can these needs be characterized so that they inform the design of the Arthritis Source?

Our approach to investigating these issues was motivated by a desire to mesh simple methods that could be easily used by most UW educators with more resource-intensive methods that are deeply entrenched in ideas about learning and teaching. In order to pursue strategies throughout this spectrum, we have evaluated site effectiveness using logfile analysis, web-based user response to an effectiveness question (the Quick Poll Simple Utility Tool), and an online survey. To better understand the learning needs related to living with arthritis, we have collected and analyzed questions from the Arthritis Source users, interviewed volunteers who run the Arthritis Foundation hotline, conducted a content analysis of an online bulletin board focused on arthritis, and surveyed the research literature on patient education and living with arthritis.

What has been learned? -- Evaluating Arthritis Source Effectiveness

- How effective is the Arthritis Source?

The effectiveness of a web-based educational resource such as the Arthritis Source may be evaluated from many perspectives - for example, whether the site accomplishes the goals of its designer or to what extent users learn by accessing the site. Given these different perspectives on "effectiveness", a variety of types of information may used as evidence of whether a particular site is effective. While PETTT's ultimate goal is to address effectiveness issues that are related directly to learning, we are also interested in exploring a wide variety of strategies for evaluating site effectiveness.

Log file analysis. We have analyzed log files of Web site traffic over a three week period in September 1999 to gain insight into how effectively the site reaches its intended audience - learners at large. Our analysis shows significant use of the site across all days of the week and all hours of the day, and suggests that learners at large are able to find and use the site. Figure 1 shows the site's level of use across the hours of the day on three Sundays and three Wednesdays during the analysis period. This chart shows that the Arthritis Source is effective in providing information at a time when other information sources may not be available - use of the site diminishes but does not vanish during the hours that correspond to nighttime in the United States. Our log file analysis also pointed to areas where the structure of the Arthritis Source may not be as effective as it could be - users do not access the full spectrum of available information, many users visit only one page, and many pages of the Source were not accessed at all during the one-month study period.

Quick Poll "*Simple Utility Tool*". A straightforward way to assess the effectiveness of an educational resource is to ask the users of the resource whether they found the resource effective. When the users are learners at large, however, it is not obvious how to identify users in order to ask this question. To address this issue, we designed the Simple Utility Tool – an embedded element on selected web pages that enables the learner to grade a page's usefulness by simply clicking on one of five radio buttons. In addition, we added a text field so that users could comment on their rating if they so desired. While such an approach to measure effectiveness may not provide deep insight, it does provide some quick feedback to an educator – feedback that could lead to deeper discussion about the site's effectiveness.

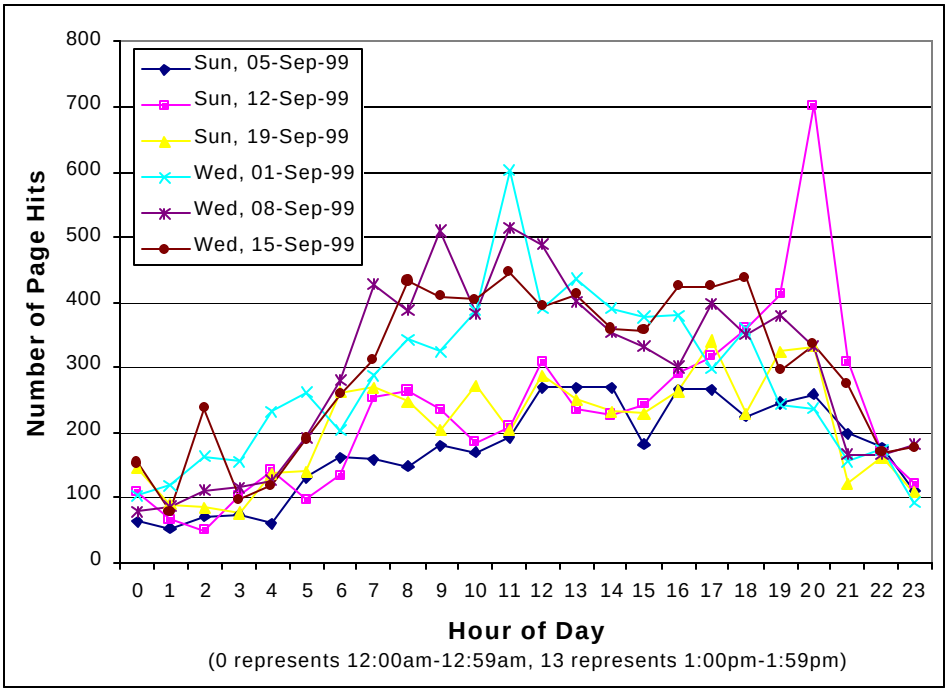


Figure 1. Level of Use by Time of Day

To date, we have added the Simple Utility Tool to three pages in the Arthritis Source and collected two weeks of preliminary data. The results from this pilot use of the tool are shown in Figure 2. From these results, we can conclude that users of the site are generally satisfied with the information provided – over 75% of the respondents indicated that the information they found was either "1: Extremely useful" or "2: Very useful." While this approach to assessing effectiveness provides the designer with immediate feedback, the drawback is that it provides little information about *why* a site is or is not effective. In order to gain this type of insight, we have designed and are currently employing an on-line user survey.

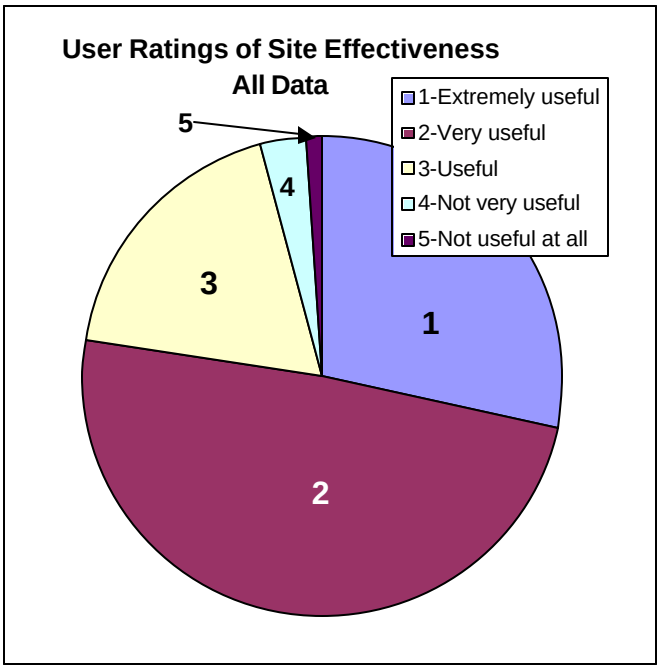


Figure 2. Preliminary results of Simple Utility Tool Evaluation of Three Arthritis Source Pages

Online user survey. We have designed and are currently using an online survey to gather information about the users of the Arthritis Source and their interactions with the Arthritis Source. In this survey, we have been attempted to explore the idea of effectiveness from two perspectives: (1) the effectiveness of the site in accomplishing the designer's goal of serving "learners at large"; and (2) the effectiveness of the site as described directly by the user.

We piloted the use of this survey during Labor Day weekend 2000, and have obtained preliminary results which suggest that the Arthritis Source is accomplishing some of the designer's goals. These results suggest that the Arthritis Source is reaching a widespread group of learners at large: of the twelve respondents, two were European while the remaining ten were distributed across North America. The results also suggest that, as the designer intended, a variety of different types of learners are using the site: nine users were patients, one was the relation of a patient, and the remaining respondents labeled themselves as "other." While the preliminary results suggest that a large percentage of users are "first timers," three respondents indicated that they had used the site previously and one indicated that he/she had used the site on 6-10 prior visits. Such a user could be said to have developed a "relationship with the information resource," another goal which the site's designer has identified as desirable. The results also suggest that learners at large frequently use search engines to locate educational resources: six respondents indicated that they had come to the Arthritis Source from a search engine.

Other survey responses will give us insight into the extent to which users perceive the Arthritis Source to be effective. Our initial results indicate that users do perceive the site to be useful - nine of twelve respondents in our pilot survey reported that they would strongly recommend the site to others. We are currently analyzing the responses to our open-ended survey questions in order to gain greater insight into the user's perspective and the extent to which the Arthritis Source meets their needs.

– What are some strategies for evaluating the effectiveness of an educational Web site at different levels, employing various levels of resources and effort?

As described in the previous section, we have used a number of different techniques to evaluate the effectiveness of the Arthritis Source, including log file analysis, learner ratings of site effectiveness, and an online survey. Each of these approaches has allowed us to gather information from and about users of the site, and we have used this information as a basis for redesigning the site.

One of PETTT's goals is to help the increasing number of faculty who put educational content on the Web assess the usefulness of their own Web sites and explore ways in which these sites can be made more effective for learners. Since the strategies we have used to evaluate the Arthritis Source may have value for other educators, we are currently exploring the concept of a suite of Site Value Analysis (SVA) resources, which will allow learners to become teachers regarding the form and substance of a site. Our goal is to develop a hierarchy of methods that can be applied to any educational Web site. These methods can be arranged in order of increasing involvement of the learner. At the lowest level are automated tools that can be implemented without any involvement of the learner - hit rate, path analysis, and search engine ranking. At the next level is our Simple Utility Tool, which enables learners to grade Web pages in terms of their usefulness by clicking on one of five radio buttons. At the next highest level, on-page email responses ("OrthoEdu") can be used to gather rich information about the needs of learners (discussed in the next section). Still higher in the hierarchy are methods, which require the extensive involvement of learners, such as online surveys. At the highest level of the hierarchy are methods that require heavy user involvement with correspondingly greater return in research results: rigorous assessment of knowledge acquisition and/or beneficial changes in learner behavior.

What has been learned? -- Exploring Learning Needs Related to Living With Arthritis

PETTT's ultimate goal is to evaluate exemplar projects in terms of their effectiveness in supporting learning. This type of analysis requires a deep understanding of the learning objectives associated with an exemplar. In the case of learners at large, these objectives are primarily defined by the learners themselves. The scope of our evaluations of the Arthritis Source to date has been restricted by our limited understanding of the goals of learners who use the site and that knowledge that these learners bring to the table. In order to more deeply address the issue of effectiveness from the learner's perspective, we have begun to address our second set of research questions:

- Who are the learners, and what are their learning needs related to arthritis? How can these needs be characterized so that they inform the design of the Arthritis Source?

"OrthoEdu" – User email utility. In order to obtain information about what visitors to the Arthritis Source want to know about living with arthritis, we have embedded an email link - "Ask the doctor your question" - in the site's Web pages. This type of facility allows users to ask questions using their own language and their own structure. By analyzing these questions, we can determine what learners want to know.

In our first iteration of the email utility during July 2000, we placed the utility on three Web pages related to specific arthritis treatments. We have collected a set of 78 messages, and have started to characterize these messages in terms of the types of outcomes that are of interest to the users. From our preliminary results, shown in Figure 3, we have determined that patients are most frequently interested in issues related to their physical condition, physical functioning, and physical therapy. While this data is limited in scope because it represents questions stemming from a limited portion of the Arthritis Source, our results suggests that this coding scheme may be useful as a basis for indexing the site content so that users can find information that is organized in a way that is consistent with the way they think about arthritis. In the upcoming months, we will also begin to analyze these data along a variety of other dimensions.

Arthritis Foundation hotline interview – interview with experts. We have also interviewed expert information providers - volunteers who staff the Arthritis Foundation Hotline - in order to better understand the kinds of questions that people ask about arthritis. These experts have deep and broad insights about the learning needs related to arthritis. From our visit to the Hotline site, we learned that patients typically have questions at three stages of their relationship with arthritis: when they are diagnosed, when they are considering surgery, and when a new treatment becomes available. From talking to these volunteers, we also discovered that many callers seek confirmation and reassurance as much as they seek information. We are currently in the process of analyzing the results of this exceptional learning experience to determine how we can use the information we gathered to redesign the Arthritis Source.

Bulletin board analysis. In the OrthoEdu analysis, we have learned about the needs of users through the questions that they ask, and in the Arthritis Foundation interview, we are have learned by consulting expert information providers. A third and complementary research strategy is to analyze the contents of bulletin boards in which participants discuss arthritis-related topics. We have analyzed the content of 150 notes in 30 discussion threads in a public, web-based bulletin board in order to better understand the goals and interests of the participants. As a result, we have identified topics that are of interest to learners but which have not to our knowledge been addressed by other information sources - for example, approximately one-third of the notes in the discussions were related to the pain caused by different types of bras. We have also uncovered evidence that stories and narratives play a prominent role in providing answers to arthritis-related questions -

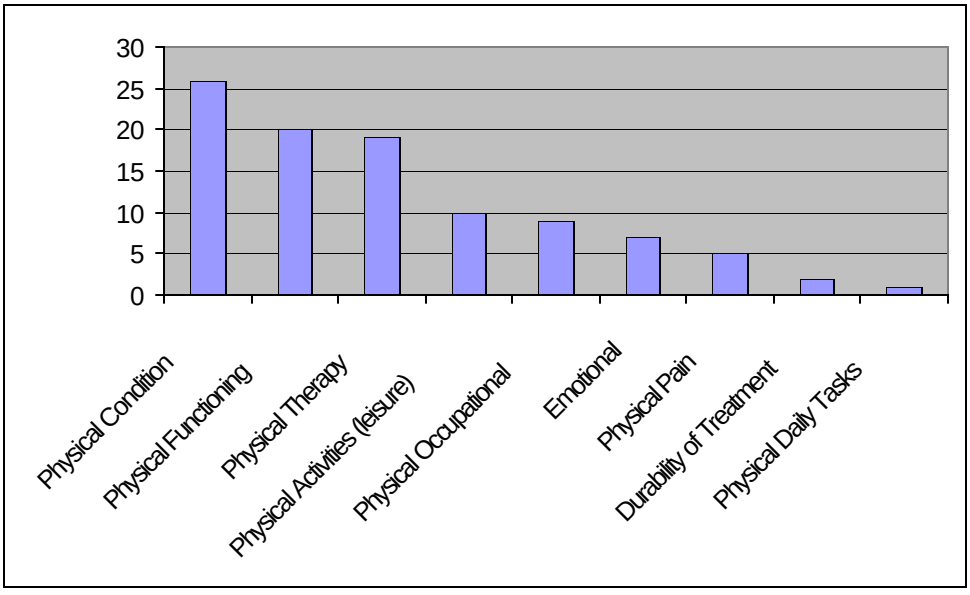


Figure 3. Number of Notes Coded as Referencing the Specific Outcome of Arthritis

approximately one-third of the notes we analyzed contained stories and narratives. These stories often contain information that answers questions not specifically articulated by learners. Finally, our bulletin board analysis suggests that social support plays an important role in helping arthritis learners - approximately half of the messages we analyzed contained some element of social support. These findings provide us with ideas for new goals and strategies for the design of the Arthritis Source and for areas for deeper study.

Literature review. Our efforts to better understand the learning needs associated with living with arthritis have led us to identify a number of themes and topics to investigate in the research literature. We have been conducted literature reviews on topics such as the role of social support in patient education, designing software that incorporates social support, and the concept of a "patient career with a disease." These nuggets of knowledge suggest ways to redesign the Arthritis Source - to allow learners to access the site from different perspectives as their information needs and concepts of arthritis change; to provide resources for social support; and to provide decision support tools for patients potentially facing surgery.

Activity 3: Refine Exemplar

Our primary reason for assessing the effectiveness of the Arthritis Source and characterizing the needs of learners is to determine how to improve the site's design. During the first year of Arthritis Source research, we made progress in refining three aspects of the Arthritis Source: (1) redesigning the site to improve search engine rankings, (2) developing a proposal for redesigning the site's architecture and content display, and (3) defining an approach to permit multiple authors to create the site's content.

Redesign to improve search rankings. One challenge in supporting learners at large is to help them locate relevant educational material. In the case of the Arthritis Source, we had anticipated (and are confirming through the online survey) that a significant portion of users would attempt to locate arthritis information Web sites using search engines. In order to increase the probability that these learners will find the Arthritis Source, we synthesized the literature on strategies used by various search engine, and used this synthesis to develop a set of heuristics about how to design Web pages to improve their search rankings. We then re-implemented parts of the Arthritis Source based on these heuristics, and compared the resulting web page rankings to the site's initial rankings. This experiment confirmed the positive effect of our redesign.

Site architecture and content template redesign. Our work with the Arthritis Source had revealed several practical problems with the site as it is currently implemented: content is presented on different pages in different formats, is out of date, and is fixed within a hierarchical display structure so that it cannot be flexibly retrieved. Flexible retrieval of information may be desirable in order to support the wide variety of needs of learners at large. These observations have led us to propose a new design for the site architecture and content display. During our first year, we have developed template for site content, and we are currently translating existing content to this new format. Our template consists of a simple format for educational materials that may be disseminated on the web, in the classroom, or in the form of informational brochures. This format treats different components of the material as elements of a database, in order to facilitate indexing, editing, and access using a wide variety of devices, such as

personal digital assistants, personal computers, and soon digital phones. We are also in the process of restructuring the Source into an XML-based format, so that the elements of the Source can be readily found, accessed, and tailored to the needs of individual learners.

Distributed Content Creation. In addition to designing a new structure for the Arthritis Source, we have addressed the issue of how to produce authorized content for the site. Our approach has been to attempt to devise a way in which multiple authors can contribute to content development, while allowing site designers to maintain consistency across the site. The new Arthritis Source content template facilitates the creation of multipurpose content by *teachers at large* – content experts who contribute new content to the Arthritis Source. We plan to evaluate the effectiveness of materials developed by different teachers at large in order to understand the strengths and weaknesses of this approach.

Dissemination

At this point in our efforts with this exemplar, we have already completed some dissemination activities and are also in the process of planning addition dissemination efforts. In the area of scholarly publications and presentations, we have two accomplishments.

- Journal paper on search rankings research. The results of the search rankings work have been turned into a journal paper to be submitted to the journal *Educational Technology Research and Development.*
- Presentation on bulletin board study. The design and preliminary results of the bulletin board study were presented at the Spring 2000 Mary Gates research symposium

In addition to publicly available scholarly publications, our work has resulted in a number of internal documents that capture the results of research efforts and collectively represent our process. We plan to make some of these documents publicly available in the upcoming year (possibly through the website). A sample of these documents is as follows:

- Site Characterization: A document containing a description and a map of the Arthritis Source site at the beginning of the PETTT research efforts.
- Log file Analyses: Two documents summarizing log file analyses conducted to learn about the use of the Arthritis Source.
- Interview with Designer – Design and Results: A set of documents describing the design, questions used, and results stemming from the "interview the designer" activity.
- Online Survey – Design and Implementation: A set of documents describing the design of the online survey, the specific questions included in the online survey, and a justification for individual questions. An extensive human subjects application is part of this set of documents.
- Arthritis Foundation Hotline Interview – Design: A set of documents describing the plans for interviewing experts at the Arthritis Foundation hotline and the specific questions to be exploring through this effort.
- Bulletin Board Study – Design and Preliminary Results: A set of documents describing the goals, design, and preliminary results of the bulletin board study.
- Living with Arthritis – An Annotated Bibliography: An annotated bibliography focused on issues associated with living with arthritis and learning about arthritis. Includes information about patient education as an intervention strategy and the role of social supports.

Another important dissemination effort is the transformation of our research into tools, techniques and guides to be distributed through Catalyst. Our efforts here are currently focused on two issues – the

evaluation of website effectiveness (specifically through our Site Value Analysis approach) and the improvement of website search rankings so that learners can find sites. We have identified (and started to develop in some cases) the following elements to be distributed through Catalyst:

- Guide - Conducting a log file analysis: This guide will synthesize the literature on log file analysis, present information on a variety of analysis tools, and give recommendations about how to use the results of a log file analysis.
- Guide - Conducting an online survey (to characterize users and site effectiveness): This guide will synthesize guidelines for designing on-line surveys, and will also contain pointers about the overall design process, expectations for time requirements, and information about possible outcomes.
- Guide - Learning about an educational technology by interviewing the designer: This guide will describe the possible outcomes of interviewing designers of educational technology, potential questions to ask during an interview, and various aspects of designing and analyzing an interview.
- Catalyst Tool – Quick Poll: Quick Poll is a tool that operates like the Simple Utility Tool described in this document. Quick Poll is currently under development by Catalyst, for release in winter 2001.
- Guide – Increasing Search Engine Rankings: This guide will describe page design heuristics for improving a Web site's search rankings and will briefly present the empirical results of using these heuristics with the Arthritis Source.

What next?

During the second year of PETTT funding, we plan to focus in three areas. First, we will continue to work on existing projects, including analyzing OrthoEdu email notes, collecting and analyzing online survey data, and conducting telephone interviews. We also plan to focus on creating a deeper characterization of arthritis learners. We are currently planning a pair of studies in which we will look at patients' conceptual understanding of arthritis and their longitudinal interaction with arthritis information resources. Our activities to date have given us some insight into the specific goals and questions of people seeking information about arthritis. A final focus of the second year will be to map these findings into design implications for refining the Arthritis Source. We have already begun this process by preparing a formal "expert" evaluation of the proposed site architecture and content template based on the insights we have gained to date.

SECTION IV. EXEMPLAR 2 – CSE TVI PILOT PROJECT (DETAILS)

In the CSE TVI pilot project, the UW Computer Science and Engineering (CSE) department is exploring the use of Tutored Video Instruction (TVI) for delivering introductory Computer Science education to community college classrooms. Modeled after the pioneering work of Jim Gibbons, the former Dean of Engineering at Stanford University, their approach uses the web to bring UW lecture video, as well as transparencies, assignments, and examinations to groups of community college students assisted by a facilitator. Students view the lecture videos together, and may stop the videos at any time to ask questions or replay segments. The facilitator's role is to guide the students towards resolution of their questions.

The Department of Computer Science & Engineering invests enormous resources in our introductory course sequence, CSE 142/143, which is taught annually to more than 2,500 students on campus.

In recent years we have sought ways to allow the state's Community and Technical Colleges (and others) to take advantage of our investment. Our approach has been an online/digital version of Tutored Video Instruction. To date, we have offered 16 sections of TVI courses, at 7 different institutions.

The careful study of TVI sections by the PETTT assessment team has contributed enormously to our understanding of the approach. Substantial modifications will be undertaken this fall in response to what the PETTT team has learned.
– Ed Lazowska, Professor and Chair of Computer Science & Engineering

The TVI approach has the potential to reduce redundant effort, to increase the quality of introductory Computer Science courses statewide, and to allow other institutions to offer courses even if qualified instructors are not available. However, although Gibbons utilized TVI for many years to deliver graduate level engineering courses to professional engineers, there is essentially no "methodologically valid" assessment of its efficacy, and little is known about how to generalize the TVI approach to other settings. How well do students learn? On what factors does learning depend? To what extent can changes in Gibbons' methodology extend the range and effectiveness of the TVI approach to education?

PETTT has worked with the Department of Computer Science and Engineering (CSE) to explore these questions and to evaluate the overall efficacy of the TVI approach for delivering introductory Computer Science course materials. We have conducted a series of classroom studies and have used the results of these studies to make recommendations about the redesign of the TVI course. As a result of our studies, CSE will significantly modify the TVI course in the current academic year.

Activity 1: Characterize Exemplar

The characteristics of the CSE TVI Pilot Project, described in Table 4, were identified through discussions with the course designers, classroom observations, and comparison with the original work by Gibbons (1977). This project represents a modified form of conventional distance education in which curricular content created at UW is combined with ongoing tutor-led sessions in classroom settings. Learners in the

CSE implementation of TVI are community college students, rather than the graduate-level professionals represented in Gibbons' original work. Tutors are community college instructors with varied backgrounds and experience with the course material, rather than previous high-performing students in the course. The learning domain consists of additive, linear material that is applied to problem-solving activities.

Table 4. **Characterizing the CSE TVI Pilot Project Exemplar**

Learners o Distance learners. The CSE TVI Project is geared towards learners who are geographically, temporally, or otherwise distributed in such a way as to make it difficult to for them to attend UW classes. Community college students. The CSE TVI Project has been implemented at seven community colleges in Washington State. These learners may choose to study using TVI because of the time and cost convenience of attending a local community institution. In addition, UW offers students "no questions asked" course equivalency for TVI courses, should they choose to transfer to UW.
Learning Domain o Additive, linear material. The CSE course material addresses foundational computer science concepts. This knowledge is additive - learners build on previously learned concepts and use their cumulative knowledge to approach programming problems. o Problem-solving skills. Introductory computer science consists not simply of a series of facts, but of knowledge and strategies that are used to solve programming problems. Writing computer programs to solve problems is an essential part of the course.
Instructional Approach o Didactic lecture. Videotaped lectures provide curricular content through lecture presentations and accompanying multimedia, such as digital slides, projected diagrams, formulas, and drawings. o Facilitated group discussion. Ongoing tutor-led sessions facilitate discussion of the didactic lecture component. Tutors encourage students to contribute questions, suggest possible answers to these questions, and reach their own conclusions about the material. During this group exchange of ideas, the tutor may also provide examples, suggest alternative solutions to problems, or elaborate on lecture content.
Structure of Learning Environment o Community College classrooms. Learning materials are accessed in a classroom setting with a community college instructor present. o Tutors with varying levels of knowledge. Tutors are community college instructors with a variety of backgrounds and experience with the course subject matter.
Characteristics of Learning Technology o Digital video streamed from host institution to remote TVI classrooms. Taped lectures and supporting materials from the UW are uploaded to a Web server for subsequent download and replay by tutors in TVI classrooms at cooperating community colleges.

Activity 2: Conduct Exemplar-Motivated Research Based on the Characterization

The initial motivation for TVI and early results about its viability are described in Gibbons (1977). Gibbons suggested that the combination of local resources in the form of small group discussion, and the disciplinary expertise represented in the taped lectures yielded the surprising result that TVI students (practicing Hewlett Packard engineers) significantly outperformed engineering students taking the traditional lecture version of the course at Stanford. Our research goals have been developed in relation

to Gibbons' initial formulation of TVI: to determine whether similar grading results would occur in the CSE context and to describe and analyze the features of local classroom contexts with greater precision.

With these goals in mind, our research has focused around three general issues:

1. Why does participation in a TVI course appear to correlate with better grades than participation in a standard large lecture course?

2. Which interactional features of TVI courses provide resources that facilitate learning? Features which may affect learning include: uses of videotaped lectures, 'break-out' discussions occurring in conjunction with the use of the video, the level of tutor knowledge about the subject matter, the level of tutor knowledge about pedagogical issues (i.e., instructional knowledge about how to help students learn the content), and the background knowledge of the learners.

3. Do students in TVI courses demonstrate learning that falls outside the learning measured by standard assessment tools (i.e., exams)? For example, students may improve their ability to verbally formulate problems or to collaborate in order to make sense of new material. Neither of these capacities are measured by standard assessments, but both would be observable in video-based interaction analyses.

In order to address these issues, the PETTT team conducted a comparative field study of TVI courses in two local community colleges during the winter and spring quarters of the 1999-2000 academic year. The source material for these courses was video recordings of the introductory computer science sequence at UW, Computer Science 142 and 143. Members of the PETTT team conducted field studies in three community college classrooms. These observational studies were guided by these questions: (1) How does the actual implementation of TVI differ from the theoretical model presented by Gibbons?; and (2) How effective is the TVI model for teaching introductory CSE programming in community college context?

What has been learned?

Over the course of our study, we observed both important similarities and important differences among the three classrooms.

Key similarities

1. In TVI classrooms, students or tutors stop videotaped lectures to raise questions, clarify content, and discuss issues. Gibbons' study emphasized this feature of the classroom context, and the video stops seemed to be initiated primarily by students. This was not the case in our study – during our observations, students nearly never stopped the video. Stoppages were initiated by the instructors, though the situations in which the three instructors stopped the tape were very different (described under "Key differences"). This issue is important because it reflects a category of lost learning opportunities - a great deal of research in the learning sciences indicates that learning is enhanced when students ask their own questions, express their own conceptions, and seek clarification in their own language, appropriate to their current understanding.

We have also questioned why the video stoppages are imbalanced in this way. Our tentative answer to this question involves the teacher-centered classroom practices familiar to students and instructors alike. We hypothesize that, in the absence of a period of training in an alternative method of interaction, class members behave in ways with which they are already familiar: with the teacher completely leading the action. The fact that TVI in theory provides an alternative model hardly determines that one will be enacted in practice. A secondary hypothesis is related to the situation in which the tapes were watched - in semi-darkened rooms with all participants gazing at a TV screen. The behavior we observed indicates that it is relatively easy to induce a passive movie/television watching experience in a TVI classroom, leaving the instructor to break the implicit cultural frame.

2. A second similarity across the classrooms involves the usefulness of some portions of the events recorded during the original lectures. Not surprisingly, some of the lecture material presented by UW instructors was not about computer science, but instead involved issues of local relevance to the UW campus and the Computer Science Department. For example, UW instructors would sometimes discuss grading policies and procedures. While these events are essential for the UW students' success, they are at best irrelevant and at worst confusing to community college students, who face different local issues. In addition, since the amount of recorded material that the TVI classes must watch is inversely related to the amount of time available for valuable discussion, students spent time watching irrelevant material and thereby lost opportunities for learning.

Key Differences

In addition to observing similarities across the three TVI classrooms, we also observed important differences which indicate that the enactment of TVI is far more complex and subject to variation than suggested by Gibbons' original study (Kors et al, submitted). This general finding reiterates the importance of a basic PETTT principle: the *integration* of learning technologies into practice is itself a challenging and necessary component of the use of educational technology.

One of the most important differences we found among classrooms was variation in the stance that different instructors took to the instruction captured in the videotaped lectures. Our basic finding, which echoes anecdotal reports we heard from a prior year's use of TVI, is that TVI instructors with significant experience teaching computer science have an ambivalent relationship to the use of videotaped lectures because it displaces or intrudes upon their own pedagogy. TVI instructors with little or no CS experience seem to have a more positive relationship to the content. It should be noted that Gibbons originally developed the TVI method using this latter population of instructors. In the classrooms we observed, two of the instructors had significant CS teaching experience and one did not. The instructor with little CS experience was a mathematics professor who not only seemed to regard the experience more favorably than other instructors, but whose students' grades were statistically indistinguishable from or better than the UW students' (Lowell, 2000). For further details and a characterization of the difference among the three instructors, see Postner & Shelton (2000).

Activity 3: Refine Exemplar

The PETTT team's observational studies led to the following suggestions for improving the CSE TVI Pilot Project:

- Given the conventional practices of classrooms, cultivating discussion and participation from students is difficult. In addition, during this pilot project, community college instructors received very little training in the TVI method. We have recommended that this absence of training be remedied with a half-day seminar for community college instructors. Such a seminar would focus on specific techniques for effectively using TVI, and their basis in theories of learning.

- Based on our observation that the pilot project videos contained irrelevant material, the Computer Science department has decided to add another step to the TVI tape production process – studio production of lecture materials. This process should eliminate confusion and make more time available for the type of extended discussion that is argued to be at the core of TVI's success.

- One of CSE's goals for this project is to provide computer science education where it would not otherwise be available. Given the ambivalence of experienced CS instructors, it seems wise to use the TVI method only with instructors for whom the method does not displace their own teaching practices. If TVI tapes are to be used by experienced instructors, it could be worthwhile to develop an augmentation model, in which TVI is not the primary mode of curricular delivery, but a satellite resource for students and/or instructors.

Dissemination

Our dissemination efforts for Tutored Video Instruction are currently based on preliminary data gathered in the first year of the Pilot Project. Based on this data, we have disseminated TVI knowledge in five different ways:

- Papers: We have written about our preliminary findings in two papers (Kors, 2000; Postner & Shelton, 2000), and have generated recommendations for redesigning the TVI Pilot Project.

- Participation in structured poster session: Graduate student researchers affiliated with PETTT presented these papers at a structured poster session for Education graduate students.

- Implementation of redesign recommendations: PETTT has discussed its findings with the Department of Computer Science & Engineering, and has presented its recommendations for redesigning the program. The second iteration of TVI will incorporate these PETTT recommendations.

- American Educational Research Association conference proposal: PETTT has submitted a proposal to present our findings at the AERA 2001 conference. This paper will contain both data from our preliminary findings and data we will gather during the second implementation of TVI.

?? Creation of a scalable TVI tool: We have also started plans to develop a scalable tool to facilitate effective implementation of the TVI approach by faculty from other disciplines.

We have learned lessons regarding the impact of instructor level of experience (not too much, not too little), thorough instructor training (essential to reduce the high disparities in performance that we observed), centralized grading (deemed essential by Gibbons, but deemed catastrophic by PETTT in our setting), and production value (we are investing this summer in lectures with far higher production value, which will compress lecture time by 1/3, give the materials a longer lifetime, and reduce various irrelevant but nagging student complaints). We also have learned lessons about the management of our on-campus course and its instructional materials – lessons that are essential for TVI, but will improve non-TVI sections as well.
– Ed Lazowska, Professor and Chair of Computer Science & Engineering

What next?

The Computer Science department will again partner with local community colleges in Autumn 2000 to conduct a series of TVI classroom experiments. We have secured human subjects approval, pending minor revisions, to study these classrooms in depth and with more precise data collection methods (e.g., videotaping actual TVI discussions and analyzing student work). We are optimistic PETTT's intensive involvement with this project will result in an approach that allows units across the University of Washington to dramatically extend their educational reach, and that positively affects on-campus instruction.

SECTION V. DEVELOPMENT & DISSEMINATION (HOW WE SHARE)

During a presentation given to a group of thirty orthopaedic surgeons—where we were demonstrating how one could use a digital video camera and a laptop to capture, edit, and import footage of diagnostic procedures into PowerPoint—one of the physicians stood up and adamantly pronounced, "I would have an easier time teaching you how to do pelvic surgery than you would have teaching me PowerPoint." I thought to myself, "he has a point."

Indeed, reducing the barrier points of entry for making use of educational technologies is a crucial driver, but underscoring the above story is the notion that even though technology may show us what is possible, it is instructional goals and needs that should drive applications of technology. It is interesting to note that once the pronouncement was made, other physicians started to add to the conversation about how technologies can respond to learner/patient expectations and information needs. They provided examples to each other of how technology can pragmatically integrate into the service of their activities. From that standpoint, one lesson learned is that faculty input is critical to the success of faculty support. Once the need was established, we were able to finish our presentation by having the physicians do some hands-on work, and although the above physician may not be a PowerPoint expert, we met his challenge and I'll be going in for my first scalpel lesson soon.

– Scott Macklin, Director PETTT

A key feature of the overall PETTT approach is to employ a variety of strategies for disseminating knowledge about how information technology can be used to support teaching and learning. We have used a wide variety of methods to 'spread the word' about PETTT, including the well-developed and widely used Catalyst, a public forum with guest speakers, presentations at Departmental retreats, and journal publications. We have sought to enlist the active participation of individual faculty, as well as the leadership of C&C, UWTV, the School of Library and Information Science, Health Science Center Educational Resources, University Libraries, and other UIF programs such as the Program in Biomedical and Health Informatics. In this section of the report, we describe our dissemination efforts, using the categories introduced in the PETTT framework section. During our first year, we have ventured in each of the directions introduced in the framework section.

Improve the exemplars:

A foundation of our process is to use research results to improve and refine the exemplars. Next iteration exemplars, therefore, embody (disseminate) the lessons that we have learned. To date, we have characterized, researched, and made initial recommendations about both of our exemplar projects. As a result, these exemplars can now more effectively extend educational opportunities to individuals who otherwise would have not had access to these resources. In the upcoming year, students at several community colleges will learn introductory computer science via an improved version of TVI. Also during

the upcoming year, arthritis learners at large will gain access to a restructured Arthritis Source containing more easily comprehensible information, as well as improved access to this information.

Add tools, techniques, and ideas to the educator's "toolbox" - Work with Catalyst:

In the course of our exemplar-based research, we strived to translate what we have learned into a form that is broadly useful to UW faculty. In order to accomplish this goal, we plan to work closely with the UW program Catalyst to develop and disseminate guides and tools that reflect our knowledge about educational technology.

To date, we have worked closely with the Ed Tech Development Group to study effective uses of Catalyst tools in teaching and learning. We have led the needs assessment and the design review phases of a second iteration of the Peer Review tool, as well as the development of the problem-based Virtual Clinic tool.

The Catalyst tools are intended to enhance the student learning experience through collaboration and communication, to address diverse learning styles, and to provide opportunities for out-of-class learning.
– *Tom Lewis, Director of Center for Teaching, Learning and Technology*

Tools that are currently available on the Catalyst Web site include:

WebQ	Generate online quizzes, surveys, and questionnaires.
PeerReview	Enable students to collaborate and review each other's work online.
EPost	Create an online discussion board for your class.
Umail	Get candid feedback from your students.
E-Submit	Collect homework assignments on the Web.
iSubscribe	Manage your email lists from a Web page.
QuickPoll (SUT)	A simple survey tool that provides instant graphical results.
Web Templates	Create stylish, well-organized Web pages quickly.

We have also developed content for "teaching with technology" guides, including a guide to help educators improve the visibility and ranking of their Web sites on search engines. This guide walks educators through a series of steps which teach them about how search engines work, how search engines rank Web pages, how to submit a Web site to Internet search engines, and how to think critically about the content and focus of an educational Web site.

Publish and present in scholarly communities – Papers and Presentations:

Since PETTT is a university-based research endeavor, it is important that we participate in scholarly dialogue and contribute to the creation of new knowledge our research area. Thus, we also disseminate the knowledge we develop through traditional avenues of scholarly publications and presentations.

To date, the following publications have emerged (or will be emerging) from PETTT efforts:

Scott Macklin's and Mark Donovan's article, "The Catalyst Project: Supporting Faculty Uses of the Web…. with the Web," received the 2000 *EDUCAUSE Quarterly* Contribution of the Year Award. UW also won EDUCAUSE'S inaugural Award for Systemic Progress in Teaching and Learning. This award "recognizes replicable, scalable, and transformational programs that have helped moved institutions toward enterprise-wide instructional systems."

Macklin, S., Lewis, T. (2000) A Catalyst for Collaboration: Supporting Technology in Teaching through Partnerships. *Conference Proceedings of ED-Media 2000*.

Macklin, S., Donovan, M. (1999) The Catalyst Project: Supporting Faculty Uses of the Web . . . with the Web. *Cause/Effect, Volume 22:* 18-25.

Macklin, S., Donovan, M. (1999) New Learning Technologies: One Size Doesn't Fit All. *Planning for Higher Education 28 (1):* 10-18.

Burghardt, J. (2000) Improving Search Engine Rankings of Educational Materials on the World Wide Web. *Educational Technology Research and Development* (being submitted)

In addition to these papers, research on the Arthritis Source has been presented at the Mary Gates Research Symposium held at UW in May of 2000. Looking to the future, PETTT has submitted a proposal to present TVI findings at the AERA 2001 conference.

Make our process visible – Web site and Presentations

While the preceding dissemination efforts focus on disseminating the results of our research, we also believe that the process through which we study the exemplars has educational value. We make our own process visible through avenues such as public presentations and our Web site so that others can learn from our process.

To date, presentations have been the primary way that we make our process visible. These presentations include:

- Educause2000, Nashville, Tennessee, October 2000
- Ed-Media 2000, Montreal, July 2000
- Summer Institute for Teaching Excellence, Forks, WA, June 2000
- Expedition 2000 UW Training and Development, May 2000
- Department of Orthopaedics Annual Retreat, May 2000
- Microsoft International Conference on Connecting Communities, April 2000
- Computing and Communication's Quarterly Support Meeting, December 1999
- University of Washington Regents, November 1999
- Educause99, Long Beach, Ca, October 1999
- Common Solutions Group, Palo Alto, Ca, October 1999
- American Society for Information Services, Redmond, WA, September 1999

Create and nurture communities on the UW campus – Supporting Forums

Because UW faculty may learn about educational technology not only through PETTT efforts, but also from one another, we create and nurture communities on the UW campus in which such learning (and thus dissemination of knowledge) can take place. Our efforts to do this range from facilitating small discussion groups, such as WebEd, to larger campus-wide forums involving famous guest speakers.

One of the highlights of our first year was the PETTT-sponsored forum "Spring Teaching with Technology", with Dr. Roy Pea and Dr. Judy Ramey. Dr. Pea has participated in an attempt to create a seamless network of advances in technology, knowledge, and learning. One of his goals is to create a national knowledge network so that researchers, schools, and industries can easily share "best practices" and new designs for using technology to enhance education. Dr. Judy Ramey presented a talk entitled "Guidelines: Web Data Collection for Understanding and Interacting with Your Users." This presentation focused on ways in which educators can take advantage of the Web's potential for interactivity between designers and users. Dr. Ramey offered strategies for obtaining data Web site users and suggested using this data for two main purposes: (1) to characterize the sites' audience and their patterns of use in order to support continuous site redesign; and (2) to build personal relationships or a sense of community on Web sites. This forum brought together participants from twenty different academic departments and disciplines. A recorded version of the forum has been rebroadcast over UWTV and has become part of the content of the UW Research Channel.

We have also supported a number of smaller forums, including the following:

- Apple QuickTime multimedia forum with Dj Erdmann, Systems Engineer, July 2000
- RealNetworks streaming video forum with Shelley McIntyre, Development, May 2000
- WebEd Meetings: WebEd is a discussion group for educators. The meetings focus on the possibilities and limitations of applying new technologies to educational endeavors. WebEd meetings offer participants the opportunity to discuss current issues in educational technology and network with others who share these interests:
  - Web sites That Work, February 2000
    Rick Ells and Scott Macklin
  - UW Toolkits: UWired and HSCER, January 2000
  - Commercial Software for Web Courses: Blackboard and WebCT, December 1999
    Richard Yalch, Professor School of Business Administration
    David Riley, Assistant Professor Department of Construction Management
  - Extending the Classroom: Integrating Web-based content into a traditional course how has this affected teaching and learning? October 1999
    Carol C. Teitz, M.D., Associate Professor, Dept. of Orthopaedic Surgery, UW
    Stephen T. Kerr, Ph.D., Professor, College of Education, UW

Bring lessons learned to new domains (via new exemplar projects):

A final form of dissemination is to translate lessons learned in one domain into new domains through new exemplar projects, bringing us full circle.

At this point, we are exploring opportunities to extend our research-informed approach to educational technology to new educational domains and contexts. One example is an opportunity to contribute to a project that uses asynchronous, web-based video communication to support patient exercise programs. This project cuts across Computer Science and Engineering, Bioengineering, and Health Sciences. In our second year, we will also actively seek projects from the Social Sciences, Arts, and Humanities, which may involve investigating and designing on-line collaborative spaces, digital design environments, and computer simulations. We have already had exciting preliminary discussions about working on a project with the Design Machine Group in the Department of Architecture.

Next Steps

PETTT's research has generated a pool of knowledge about using technology to support teaching and learning. As PETTT moves forward, we plan to continue dissemination efforts in all six areas. We are particularly excited about the possibility of disseminating our knowledge through Catalyst as tools and guides. The following guides are under development.

?? Conducting a Log file Analysis– This guide will synthesize the literature on log file analysis, present information on a variety of analysis tools, and give recommendations about how to use the results of a log file analysis.

?? Conducting an Online Survey (to characterize Users and Site Effectiveness): This guide will synthesize guidelines for designing on-line surveys, and will also contain pointers about the overall design process, expectations for time requirements, and information about possible outcomes.

?? Learning about an Educational Technology by Interviewing the Designer: This guide will describe the possible outcomes of interviewing designers of educational technology, potential questions to ask during an interview, and various aspects of designing and analyzing an interview.

?? Effective facilitation of online discussions: This guide will describe how to increase student interaction using Web tools such as EPost, an online discussion tool.

?? Authoring and presenting streaming video: This guide that will describe the process of creating, capturing, editing, and streaming video and multimedia via the Web utilizing C&C's streaming servers.

We are also working with C&C to determine whether to buy or develop an enterprise-wide statistical Web site analysis tool. Our goal is to help Web developers understand the use of their sites, and to create metrics for using this tool to assist in monitoring, assessing, and designing educational Web sites.

SECTION VI. PROGRAM EVALUATION (HOW WE'RE DOING)

From the beginning, an integral part of the Program for Educational Transformation Through Technology (PETTT) has been an ongoing evaluative function, comparing the functioning and outcomes of the program to its stated objectives. In contrast to project-level evaluation of particular instructional practices and tools (reported elsewhere), this evaluation provides a broad overview with two ends in mind: first, to provide program leadership with regular feedback regarding the conduct and direction of the program (we specifically wish to avoid what some have termed "mission creep"); and ultimately, to inform both program leadership and the University community about PETTT success in achieving its mission:

> *To employ modern technology to help teachers to teach, to help learners to learn, and to help the University of Washington disseminate its knowledge broadly across the state, region, nation and world.*

During this first year, the evaluator has functioned primarily as a "participant-observer," sitting in on many working meetings, talking informally with program researchers, meeting on a regular basis with program leadership, and providing written reports summarizing progress on a monthly basis during the first few months of the program.

The evaluation of the program considers: (1) the development of a functional *program structure and process*, (2) *products* created, (3) *dissemination* to target groups, (4) *leveraging* of program resources by means of external funding or commercialization of products, and (5) evidence of *changes in teaching and learning*. As a general statement, it can be said that in this, the first year of program operation, the primary focus has been on the first three of these objectives: establishing a program infrastructure, beginning the investigation-modification cycle with each of the exemplars, and disseminating tools and approaches.

Program structure and process

Organizational infrastructure

In one sense, PETTT has been in what might be termed a "start-up mode" for much of the first year, with personnel and functions gradually being brought online. As noted in Section II: *Program Operations*, the Program Director was hired in September of 1999, the budget was officially established in January of 2000, and critical staff (two research scientists and three technical analysts) were hired over the course of spring and summer. However, because some of the now-permanent staff functioned very effectively in an acting capacity during the earlier months, and because of the expertise and commitment donated by CELT, considerable progress was made in both research and dissemination (see following section).

Channels of communication

Because PETTT has only very recently been fully staffed, working groups have had the advantage of being small enough that almost everyone could be involved in almost everything. This has facilitated communication among staff members with different functions in the iterative research and development cycle. However, the working groups are now large enough to require deliberate attention to channels of communication.

Selection of exemplar projects

An important process that has not yet been formalized is the selection of new exemplar projects. Because of the early withdrawal of The Interactive Encyclopedia of Pacific Northwest Forests" (IEPNF), one of the originally proposed exemplar projects, PETTT has focused on two exemplars rather than the intended three. This has had two unexpected benefits: it has allowed time for development of the program infrastructure during the first year and provided an earlier-than-expected opportunity to establish and "try out" a preliminary set of exemplar selection criteria.

Products and dissemination

Research products

As described in preceding sections, a surprisingly large number of research products were created during this first year of PETTT operation. Admittedly, undifferentiated totals don't convey information about the quality or impact of the work, but they do give an impression of the magnitude of the effort. Still to come are research studies relating to the effectiveness of the exemplars in their mature forms (referred to above as "project evaluations") or contributing to the science of learning in a broader sense and published in the professional literature.

Dissemination of PETTT products and findings

Dissemination efforts during the first year have focused primarily on introducing PETTT to the educational community (on-campus and nationwide) as an active agent in providing information and resources, facilitating discussion, and undertaking serious investigation of the use of technology in learning and teaching. One major forum was held in which nationally recognized researchers spoke on issues in pedagogical uses of technology, and several smaller meetings addressed specific questions at the departmental or unit level. Additionally, presentations were made at seven national or international conferences and to an equal number of UW constituencies. Specific plans have been outlined regarding additions to the Catalyst Web site in the form of both user guides and tools.

Leveraging resources, and evaluation of program-level outcomes

Leveraging PETTT resources

The sections above addressing the development of a program infrastructure and the creation and dissemination of products and findings to a great extent can be considered intermediate goals (or necessary but not sufficient conditions) relative to the achievement of the overall goal of improving the quality of teaching and learning. Another intermediate goal, leveraging of PETTT resources by means of external funding and possible commercialization of PETTT-created tools and resources, is yet to be addressed. Preliminary discussions have been undertaken with the Office of Technology Transfer to inform product development, and more specific action will be undertaken as the instance arises. External funding has not yet been sought.

Outcomes

It is too early to assess attainment of the program outcomes identified in the original program proposal such as the documentation of (1) the number and diversity of faculty who have used PETTT-created resources;(2) the efficiency with which new programs are created by faculty; (3) the diversity of learners,

settings, and topics to which the strategies and technologies can be successfully applied; or (4) meaningful insights gained into the science of learning. However, to provide a baseline with respect to some of these outcomes, a survey of UW faculty relating to their current uses of technology will be conducted during the coming winter quarter. The survey will also allow comparison to other institutions similar to the UW.

Conclusions

Overall the initial implementation of the PETTT program has gone very well in that it (1) corresponds closely to the program structure originally proposed; (2) although staffing was completed gradually over the course of the year, the program is now completely staffed; (3) the program structure in place seems appropriate to allow development and dissemination of effective products; (4) a large number of preliminary or even intermediate products have been created over the course of the year; and (5) program leadership has been very effective in maintaining program direction. At this time, PETTT is moving from the developmental to the fully functioning stage, and adaptations in the channels of communication and patterns of teamwork will need to be made. As one component in this accommodation, the Program Operations Group (POG) has been created to ensure the active involvement of all PETTT constituency groups in program direction. This group will act in an advisory role to the PETTT Director. During the coming year, preliminary evidence will begin to emerge relative to the effectiveness of the program in making positive changes in teaching and learning by facilitating use of and capitalizing on the capabilities of technology.

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