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A Vision of the Future: Remodeling the Knowledge Architecture of the University of Washington

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EXECUTIVE SUMMARY

As a University Initiatives Fund program, PETTT's purpose is to facilitate thoughtful and innovative educational technology uses at the University of Washington. PETTT listens to learners and teachers alike in order to bring the sciences of learning to teaching with technology.

Universities are faced with the challenge of being aware of and responsive to continuous, rapid technological change. The goal of this study was to inform the design of tools and services that capitalize on successes, meet challenges, and ultimately serve the community's needs and desires best.

Nearly 3,000 faculty and students responded to the surveys or participated in the focus groups that comprised this community-wide study. Researchers triangulated data by combining quantitative and qualitative techniques with the aim of constructing a complete analysis.

This report reveals the first comprehensive set of data in the history of the UW to investigate expectations, uses, and perceptions of educational technologies. Prominent findings include:

- Students from every discipline expect a significant increase in their ability to use technology while enrolled at the University of Washington. They expect this training to be provided in large part by the University.
- Students would like technology to be employed consistently throughout the University; however, faculty rate the importance of technology in their courses significantly lower than students do.
- Students overwhelmingly regard their abilities very highly for critically evaluating information they find on the Web. Faculty strongly disagree, and would like the University to continue to support them in building information literacy skills into the courses they teach.

- Faculty frequently express the desire to improve their students' learning experiences through technology; however, they identify many barriers to technology adoption.
- Both faculty and students suggest training faculty how to effectively develop, use, and integrate educational technologies into their curricula.
- Interactive electronic communication is a new social context for student learning. A large percentage of students are using these technologies everyday for their coursework at the UW.

The authors have chosen an architecture and design metaphor for presenting the findings. PETTT reports this research with the understanding that institutions must balance opportunities with cost while prioritizing evidence-based decisions regarding technology use in the service of education.

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INTRODUCTION

The University of Washington has established a foundation solid in the knowledge and research of the university. However, we as a community are constantly being challenged to remodel the knowledge architecture of the future, an architecture that is responsive to the continuous technological changes that our community undergoes everyday.

This report brings the vision into clear focus, a vision where technology is seamlessly integrated into the UW campus. As technology permeates faculty and students lives in both academic and non-academic environments the University must react to the fluid transformations technology has brought to the new revolution in education.

Presently students are embarking on their academic careers with the knowledge and desire to use technology during their experience at the university. They expect to learn cutting edge technologies. Nearly 20% of today's college students began using a computer between the ages of 5 and 8, and by the time they were 16 to 18 years old, all current students had begun using the computer (Jones, 2002). In addition, 79% of students agreed or strongly agreed that Internet use has had a positive impact on their education (Jones, 2002).

A survey administered among the University of Washington's undergraduate student population indicated that more than 80% used a computer daily, and 75% reported using a computer capable of browsing the Web from their residence (UW Teaching Academy, 2001). When UW's Office of Educational Assessment administered a survey asking students to rate the importance of seventeen abilities, among the top five was the ability to work with technology (Macklin, 2001).

As students' expectations and abilities to use technology continue to increase our community must ask the question: How can we remodel the knowledge architecture of the university to integrate useful, desired technologies most effectively?

The Program for Educational Transformation Through Technology (PETTT), a University Initiative Funded group aiming to apply the sciences of learning to develop technology-based approaches, answered this question through engaging in *Listening to the Learner*. The methods employed in this multidisciplinary study aimed to transcend the qualitative and quantitative debate by coupling various research strategies. For this study, we developed four intricately related components: faculty survey, faculty focus groups, student survey, and student focus groups. See Appendix A for a detailed description of study methods.

This project aimed to:

- Determine what educational technologies are presently being utilized on campus and the perceived benefits, disadvantages, and challenges to their integration into the community.
- Inform the iterative process of educational technology design and development to meet teacher and learner needs.
- Guide faculty in adopting effective and innovative technology use strategies that are driven by their pedagogical goals.
- Define faculty and student perceived barriers to adopting educational technology
- Articulate future research directions

These goals were achieved by the metaphorical process of remodeling the existing knowledge architecture, including visualizing the design, creating a blueprint, framing the new structure, and upgrading the existing electrical system.

Visualizing the design:

Through listening to the community's definition of educational technology and their preferred methods to learn how to effectively use technology tools, we have visualized and subsequently articulated a design for the new knowledge architecture that effectively integrates educational technology into the UW community.

Blueprint for remodeling:

The plan to adopt a modern knowledge architecture must not only incorporate the visualized concepts identified by listening to our community, it must complement our community's multidisciplinary nature. We achieved this complement in our blueprint by investigating how students and faculty would like technology integrated into the future classroom and curricula across all disciplines. By creating a blueprint that is adaptable to many different fields of study, the plan can be implemented throughout our diverse community.

Framing the new structure:

We built the frame of this new knowledge architecture with the goal to develop an enduring, stable structure. This stability was established by defining the discrepancies between faculty and students' uses, perceptions, and expectations of technologies and how these points of weakness and frustration can be resolved through recommendations designed to inform various groups, departments, and leadership within the University. To provide additional strength within this knowledge structure, we defined the intersections between faculty and students regarding expectations and uses of technology and are using these points as the pillars of strength within the architecture.

Upgrading the electrical system:

When considering the implementation of this plan to integrate technology into the University's knowledge architecture, the community identified barriers to constructing the design. To overcome these barriers we have established substantial revisions in the metaphorical electrical system. With a change in energy flow within the University these present barriers can be avoided to facilitate a smooth integration of technology into the university community.

FINDINGS

I. Visualizing the Design

Defining educational technology

To bring a vision of the future knowledge architecture into focus we first listened to the community's definition of educational technology. We learned what educational technology means to faculty and students, how it is impacting students' learning experiences, concerns faculty and students have surrounding those educational technologies, and perceived benefits to implementing various technologies into a college curriculum. This data has enabled us to determine what tools are imperative to integrate into the design of the knowledge architecture to meet the needs of both teachers and learners.

The definition of educational technology was strikingly similar across the University of Washington community, consisting of particular tools that are integrated into students' and instructors' academic and non-academic lives. Specific educational technologies defined by instructors and students as integral to their work at the University included: Course Web sites, PowerPoint, Discussion Boards, Email, Library Reserves, and Using the Web for Research.

Course Web sites

Instructors stated they are using course Web sites. Thirty-seven percent of faculty survey respondents already use the Web to mount course materials, and another third of faculty (33%) reported that they would *very much* like to use the Web to post course materials if support and service were easily obtained. Motivators described by instructors to develop and integrate course Web sites into their curricula included: the simplicity of providing information to students, perceived expectations of the University community, students, and colleagues for use, and ease of communication in large courses. Instructors who implement course Web sites explained that this educational technology requires students

to maintain a greater responsibility to keep informed about their courses, decreasing some of instructors' workload.

"I teach a class of 600 people, the course Web site is very useful for a group that size."

-Faculty Member

One obstacle instructors defined when developing course Web sites was the difficulty in keeping the information on the sites current. Portable Document Format (PDF) files were considered by faculty as a solution to this challenge, seen as a useful, timely way of updating content. Furthermore, instructors stated they are using PDF's to eliminate duplicative efforts when disseminating repetitive documentation such as syllabi.

"Everything I design ends up as a PDF file that can be easily downloaded and printed out."

-Faculty Member

Students also defined course Web sites as extremely useful tools, 60% of students reported they are using them several times per week, and 26% of these respondents reported using them *everyday*. Furthermore, student survey respondents' self-rated expertise was not significantly correlated with course Web site use ($p = .187$). Students who consider themselves to be novice to expert computer users all frequently use course Web sites.

Students explained that course Web sites are the most effective and efficient manner to disseminate information widely in an academic setting. They also described those professors who provide a course Web site as taking an active interest in student learning.

"It's nice to see that some professors put a lot of stuff on the Web page. It shows that they care whether or not you learn."

-Undergraduate Student

Many students expressed a desire to have course Web sites mandatory across the University, as they not only provide a central location to easily access information pertaining to a course, but they are successful in strengthening and clarifying course material presented to students in lecture. Forty-seven percent of student survey respondents *strongly agree*: the UW should require all courses to have a course Web site.

“Course Web sites provide an opportunity to give more information on what is presented in the course. They embellish the course material for those that have a greater interest in the subject and want to go beyond.”

-Undergraduate Student

Students reported that course Web sites should not only be mandatory, but their design should be consistent across the University. Those departments that have established a standardized interface and content for course Web sites are described by students as helpful by simplifying the process of accessing critical information for courses.

“The initial page should be the same. The basic information should be laid out the same way for all courses.”

-Undergraduate Student

“I think if the teacher’s goal is to make sure that everybody gets it, I think the Web page is definitely the best way.”

-Undergraduate Student

Specific components identified in student focus groups as valuable to include in a standardized course Web site design were: anonymous feedback, homework solutions, grades/grading criteria, discussion boards, and links to undergraduate research opportunities. These course Web site features, along with other components, were investigated further in the student survey.

Students were asked to rate how important various online resources are to have available in their courses. On a four point scale, with “0” meaning not important and “3” meaning extremely important, over half of student respondents reported that it is *extremely important* to have course syllabi and course outlines or lecture notes online (*Mdn*=3.0). Additionally, over half the student respondents rated grading criteria, problem sets or exercises, course grades, links to course reserves, links to other archived material, links to research opportunities, links to related sites, links for anonymous feedback and quizzes or surveys as *very important* (*Mdn* = 2.0).

“Course Web sites are incredibly useful if they are well organized...having their PowerPoint slides up there, their PDF files, or information about the course, past notes...the schedule, the syllabus, all that kind of stuff is really helpful to have available.”

-Undergraduate Student

Though faculty described a desire to mount their course materials, they rated several online resources less highly than students did. Students rated the importance of online materials **significantly** higher than faculty, including course syllabi, course outlines or lecture notes, grading criteria, links to course reserves, quizzes or surveys, course grades, simulations or visualizations, and presentations of compositions, dances, or other musical/art activities $p < .001$. See Table 1. Interestingly, though faculty rated these student-used technologies as less important, those tools designed to assist them in their work were regarded highly. For example, 50% of faculty respondents reported they would *very much* like to use the Web to submit final grades.

Presentation Software: PowerPoint

Instructors described PowerPoint as rapidly emerging as the minimum standard for classroom presentation, both for themselves and for their students. Seventy-four percent of student survey respondents agreed: students would like faculty to use PowerPoint in their courses.

Surprisingly, a third of faculty survey respondents reported they have never used PowerPoint to support their instruction (33%). Faculty focus group participants explained that this presentation software limits their creativity by locking them into a demonstration model. This perceived limitation may be a contribution to the large faculty population who has never used PowerPoint.

“I can’t PowerPoint. It drives me crazy, it is so uncreative.”

-Faculty Member

Faculty in the focus groups who described using PowerPoint to support their instruction shared the belief that it is relatively easy to learn since it shares features and functions with other tools, such as Microsoft Word, in the widely dispersed Microsoft Office suite. They also described the tool as an enhancement to their lectures by allowing them to provide visual representations of course concepts.

“PowerPoint allows me to demonstrate course content.”

-Faculty Member

“The technology allows me to demonstrate with visual examples.”

-Faculty Member

Students explained that PowerPoint enhances their learning by helping them focus on lecture content. The tool affords visual demonstrations of difficult concepts and can serve as a reference point for students in comparing their lecture notes with the professor’s notes.

“You can actually concentrate on what the professor is talking about.”

-Undergraduate Student

“He’d have these images up and then you would get the topic and some basic information and a couple visuals on the information and then he would talk about that topic and when he was done he would move to the next slide. It fit very well with the way he lectured. He used it very effectively.”

-Undergraduate Student

Students stated that when PowerPoint is used ineffectively they often disengage from the lecture. Ineffective use of this software, as defined by students, includes content that is word-for-word what will be discussed in lecture, a lack of software proficiency among instructors, and slides that are difficult to read.

“If the whole lecture consists of the instructor reading PowerPoint slides to you, that’s useless because we can read just as well as they can.”

-Undergraduate Student

Electronic Communication

Students and faculty are using electronic communication for their UW coursework and research. Seventy-five percent of student survey respondents rated their ability to use a computer to communicate with others as advanced or expert and every respondent claimed they had tried to use a computer for this purpose. Students reported that their two most preferred methods for electronic communication are Discussion Boards (55%) and Email lists (87%).

Discussion Boards

Fifty-nine percent of faculty survey respondents would *somewhat* or *very much* like to facilitate class discussions online with tools such as discussion boards. However, only 13% of faculty reported that they are presently using this technology in their courses. Those instructors who use the discussion board described it as a tool they have used with varying success.

Faculty identified many benefits of using discussion boards in their courses. These included: the ability for preliminary student-to-student discussion online, enhancement of the content and effectiveness of class discussion by freeing class time to take conversations to “the next level”, the anonymity students feel for expressing their opinions, and the ability to encourage shy individuals to participate.

“One thing we noticed with the discussion board is that some students that would not offer any opinion in class were feeling freer to offer opinions in a discussion board. There was something about sitting down and typing it ... they had the ability to think through it and edit it. We often got better participation in discussion boards from a broader segment of the class than we did in class discussion.”

-Faculty Member

“I think students get online and talk to each other about concepts that they’re fuzzy about, without anybody knowing who they are. That seems to help them figure out concepts in a way that’s less threatening.”

-Faculty Member

Instructors generally agreed that the quality of online discussions, like classroom discussions, depends on the “personality” of each class, and that discussion boards change the boundaries of communication between students.

Instructors stated that they need guidance to help students make the best of online communication. They also want assistance in designing activities involving discussion boards that maintain and enhance their pedagogical goals.

“You have to remember that speaking and writing are cognitively very, very different things, and it's not just a matter of the technology letting you move a discussion outside of class instead of taking up class time, but you're really changing cognitively what students are doing. To some degree the medium is affecting the content.”

-Faculty Member

On the student side, 64% of student survey respondents reported they have *never* used a discussion board for their coursework at the UW, yet 55% of student respondents reported they would like faculty to use this technology in their courses. These findings may indicate that students who have had the opportunity to use discussion boards would like this technology to be more widely integrated into their courses. In the interest of understanding why discussion boards, although not widely used, are preferred as a mode of online communication by students, we investigated student uses and perceptions of discussion boards further in our qualitative work.

Students stated that an integral part of understanding course concepts is working in collaboration with peers.

“It's a lot easier if students teach students” (Student's emphasis).

-Undergraduate Student

Students reported that discussion boards are being utilized as a method to facilitate this collaboration, enhancing communication for problem-solving both from student-to-student and student-to-instructor perspectives. Additional benefits described by students of using discussion boards were the ability to smoothly disseminate information across the entire class and provide a highly organized, timely, easily accessible route to gather and exchange information. In result of these benefits, students in the focus groups defined Discussion Boards as a tool that should be available in every course at the University of Washington.

“Overall, one thing that needs to be on every course page that I ever go on is a discussion group because they are so useful.”

-Undergraduate Student

“Every class should have a default discussion board every quarter.”

-Undergraduate Student

“A lot of my friends and I were talking about it this quarter and we really want to talk to our professor and have a discussion board set up because it is nice when you have homework due the next day and you want help, you can post it on there and somebody might know how to do it.”

-Undergraduate Student

“I think discussion boards help me to understand course concepts. It also encourages me to learn because if I understand I can explain it to another person.”

-Undergraduate Student

“Discussion boards facilitate the learning process.”

-Undergraduate Student

Email

Faculty and students equally depend on email as a mode of communication for their coursework and research at the UW. Eighty-three percent of students reported using email *everyday* and 83% of faculty reported using email *daily*.

Instructors stated they are using email to communicate with their students and believe students like the open, anytime access to instructors that email affords. Instructors also perceived students to be fluent in this technology.

“Email, it’s the immediacy aspect I really like about it.”

-Faculty Member

Email was described by students as the primary mode of communication between students, professors, and TA’s. Students expressed their preference for this electronic communication to be a result of its ability to archive and organize messages, the convenience of asking questions without attending office hours, and the dissemination of information from one person to a listserv of classmates. Eighty-seven percent of student survey respondents agreed, they not only want to use email to communicate with students and instructors on an individual basis but they would like faculty to use class listserv’s to circulate information.

“I find most professors prefer to do it over email. It’s easier, they can get to your question when they have time and when they’re focused on it.”

-Undergraduate Student

“I never go to the office hours, I just email. I don’t have time to go across campus to find help.”

-Undergraduate Student

Faculty agreed with students: class email listserv’s are useful in large classes. Fifty-seven percent of faculty survey respondents are presently using email lists of students in their courses and an additional 30% of faculty would *very much* like to use email list-serves as a resource to support their work at the University if support and services were easily obtained.

Electronic Reserves/UW Library Resources

Electronic reserves were defined by UW community members as a valuable educational technology. Although faculty and students shared this belief, faculty expressed concerns surrounding the use of this technology. They voiced an apprehension to use this resource for fear that their students are struggling to effectively access information within the e-reserves system. Faculty also articulated frustrations with the extensive time requirement to download electronic reserves from slow off-campus Internet connections. Finally, faculty who are presently using or desire to use this technology explained that a barrier to using this resource is the long wait to have their course materials posted online within electronic reserves.

Students reported they are using electronic library resources frequently to access information for their courses. Over half of the student respondents reported they are using the online UW Libraries Catalog several times a month or more and 46% of respondents *strongly agreed* that library course reserves should be provided electronically.

Opposing faculty concerns, 72% of student survey respondents reported they can *usually* or *almost always* easily find and use online library resources. This defines a discrepancy between the students and faculty regarding their perceptions of electronic reserves.

Student and Faculty Research on the Web

Thirty-five percent of faculty survey respondents reported they are using the Web to conduct research for their work at the University. They also explained that they are encouraging their students to engage in research on the Web. Though this encouragement is occurring, instructors described a need to develop students' abilities to critically evaluate the information they find on the Web. Instructors stated that students' Web skills are outstripping their database searching and information literacy skills. In

response, most instructors explained they are incorporating one or more lessons on fluency in information technology into their curricula.

Instructors stated that students are using the Web widely to plagiarize. Some instructors described technology-based solutions, such as plagiarism-checking software, for these technology-borne problems. Many instructors reported that limited exposure to proper research methods that incorporate new media may be to blame for increased unintentional instances of plagiarism among their students.

“There are so many sites you can go to, you can find a paper on just about any subject at all, and it’s so hidden...no instructor can know every single site.”

-Faculty Member

“It’s how do we move into the discussion, how do we engage the students with the material and with each other, one another, and the Faculty. And if they can get the information off the Web and then we use the classroom to begin to integrate, and synthesize these higher order things, then it can improve learning.”

-Faculty Member

“Whether they’ve actually read the articles that they’re citing, that’s a different question.”

-Faculty Member

“That’s the critical question: is the information they’ve found valid?”

-Faculty Member

Students reported that they often utilize information they find on the Web to connect course content with the world outside academia, particularly when they have a personal interest in pursuing the subject matter. Over 2/3 of students are using Web browsers (78%) and Internet search engines (70%) for their UW coursework and research everyday.

Students also stated they are using the Web to research career opportunities and locate additional information that will help them gain a greater understanding of course content.

“The Web has the whole subject covered, not just information from class.”

-Undergraduate Student

“I like information on the Web, the things you read to explore what else you could do with the subject other than just take a class and not use the information.”

-Undergraduate Student

“I expect to understand the framework with which that class is looking at the world.”

-Undergraduate Student

Video Clips

One of the student-preferred technologies for presentation in the classroom was audio/video clips and slides (75%). Students described this technology as a tool to use in conjunction with lecture material to reinforce the information presented in class. They defined this technology as a tool to create bridges between the formal knowledge provided in coursework with larger societal concepts.

“Video clips connect the real world, what’s going on in today’s business or society, with what we’re learning in class. Then you don’t think you’re wasting time in school while the world is passing you by.”

-Undergraduate Student

“Video clips are easier to relate to than what we learn in the book, it’s nice to have both.”

-Undergraduate Student

“Video clips reinforce the facts.”

-Undergraduate Student

Twenty-nine percent of faculty respondents reported they are using slides, filmstrips and/or movies at least once a month to support their instruction. Furthermore, 33% of faculty reported they would *very much* like to use audio video clips, animations, or slides if support and services were easily obtained.

Student-Specific Educational Technologies

Course Web sites, PowerPoint, discussion boards, email, using the Web for research, and video clips were technologies discussed as imperative to integrate into the knowledge architecture by both students and faculty. However, students expressed a desire to have particular educational technologies integrated into their UW coursework that were not addressed by faculty. These student-valued tools are included in the vision of our future knowledge architecture.

Instant Messaging

Instant messaging was a technology described by students as being widely used among the UW student population. Astonishingly, 30% of student survey respondents reported they are using instant messaging *everyday* for their UW coursework and research. Benefits described by students to using this technology were its ability to facilitate collaboration between peers and the capability to communicate instantaneously, allowing questions about course content to be answered in real-time by their fellow students.

Instructor focus groups did not discuss this technology being utilized in the UW community, and only 20% of students reported they would like instructors to use instant messaging to communicate in their courses. These findings indicate that

instant messaging is a technology used primarily by students to communicate among each other, truly a new social context for learning!

“In Chemistry we all exchanged IM names on the discussion board. Then everyone IM’s each other at odd hours of the night when you can’t reach TA’s.”

-Undergraduate Student

“You make friends in a chat room and if you’re having a problem or you want to meet and study somewhere, you just talk to them online because everyone’s online anyway.”

-Undergraduate Student

“You can ask people a specific question and you don’t sit around and wait for a couple of days to see if someone will email you back. It instantly responds. Everyone is going in there [a chat room] confused with the homework. Someone will figure it out and then there is a whole chain of people understanding.”

-Undergraduate Student

Excel

Eighteen percent of student survey respondents reported they have never used a spreadsheet, and 21% of the respondents rated themselves as novice at this skill. However, by graduation, 76% of students would like to perceive themselves as advanced or expert at using spreadsheets. Students described a desire to learn how to use Excel effectively. To students, effective use is providing meaningful representations of numbers and mathematical or statistical concepts.

“Learn what the numbers mean instead of just looking at it as numbers.”

-Undergraduate Student

Faculty did not discuss Excel as a prominent technology on campus in the focus groups, although one third of faculty survey respondents reported they are using spreadsheets and databases at least once a week for their own work and research at the University.

Faculty may be unaware of students' desires to use Excel in coursework. Only 12% of faculty responded to open-ended survey questions that students should be able to use databases or spreadsheets during their University careers. Only 14% of faculty reported students should be able to use this technology by graduation.

Undergraduate Research Opportunities

The University of Washington is an established research institution; an institution that recognizes that undergraduate research enables students to participate in the advancement of knowledge and better grasp the process of analysis and discovery. Students also described an understanding of the value of undergraduate research and expressed desires to become more involved in research themselves.

A student-defined barrier to engaging in research on the UW campus is the difficulty they have identifying the opportunities available to them. Students requested that when instructors have undergraduate research positions unfilled to notify them through links to undergraduate research opportunities on course Web sites. Sixty-two percent of student survey respondents reported that having links on course Web sites to undergraduate research opportunities is *very* or *extremely important*.

“Listing research opportunities is a big bonus point for Web pages. It becomes easier to get involved in research if you have access to that information online or ahead of time, it is so helpful.”

-Undergraduate Student

Less Frequently Used Technologies

When conceptualizing a vision of the UW's future knowledge architecture, it has been imperative to include not only those technologies defined as integral to faculty and students work at the UW, but to address the technologies reported by the community as used less frequently.

Over half of the students reported *never* using a number of educational technologies for their coursework and research. See Table 2. Parallel to this finding, over half of faculty respondents reported *never* using many technologies listed on the faculty survey. See Table 3.

These findings do not indicate that these particular tools should not be integrated into the knowledge architecture of the future. They may indicate the lack of exposure and use of certain educational technologies across the UW community. As these tools continue to be studied in academic environments and undergo the iterative process of development to meet the needs of teachers and learners, one might expect that many of these tools will be integrated into the knowledge architecture. However, there were a few technologies that are presently not being used and the community reported they do not desire to use them in the future.

Greater than a third of students think that video archives of lectures are only *somewhat* important (36%), and an additional 30% said they *weren't important at all*. Faculty agreed, 22% of faculty respondents were *not at all interested* in using video archive lectures or conferencing.

Approximately one third of faculty respondents are *not at all interested* in using the Web to post student work (32%) and 27% of student survey respondents believe posting student work to be *not at all important*. Another 36% of students believe that this online resource is only *somewhat important*.

Preferred methods of instruction

A complete visualization of the knowledge architecture not only includes the technologies that comprise the structure, but incorporates the methods in which the community prefers to learn how to effectively develop, implement, and utilize these desired technologies. Such instructional approaches are defined both by preferred methodologies and learning contexts.

Faculty Preferred Methods

Faculty survey respondents reported their three most preferred methods for computer learning as: help from colleagues, friends, and family, exploring/experimenting, and local technical support. In faculty focus groups we investigated these methods further.

Faculty elaborated on their preferred context to receive local technical support. They described a preference for the instruction of educational technologies to be provided by individuals who can come to their offices and train them on their own equipment. Furthermore, faculty suggested that those individuals training them not only be competent in the technical aspects of the tools but teach them in a manner that does not divorce pedagogy from technical training. Faculty described a desire to be instructed how to design and develop technologies that align the technology with their pedagogical objectives, innovatively enhancing their teaching practices, *and* meeting their skill-focused training needs.

“We need more people who really are experts, not just in the computers and the software, but in the kind of academic applications and problems that we deal with, as opposed to industry or private business.”

-Faculty Member

“Seems like somebody who can talk very fluently about the technology, but not remember what our goals are in teaching a class, is not going to help us in the same way.”

-Faculty Member

“There just aren’t enough humans providing technological assistance at the University right now.”

-Faculty Member

Faculty described ongoing workshops, such as Catalyst workshops, as less useful than one-on-one, just-in-time training. Ineffective workshops are defined by instructors as those that are task-independent and do not meet them at their particular skill levels. Instructors identified workshops as useful if they focused on lower-level skills. They stated that other special workshops, like those at the Institute for Teaching Excellence, were more useful in helping them integrate technology effectively in their teaching practices.

A helpful source of support projected by faculty was guided online tutorials addressing both pedagogical and technical concerns on how to use educational technologies in a classroom. They suggested these materials be indexed by task, and where relevant, specific to the University of Washington. Faculty also noted that existing resources should be better publicized.

There was a portion of faculty that did not describe a preferred method to learn how to use technology, as they believed their ability to effectively use educational technologies was already developed. These individuals stated that they are occasionally developing their own technologies when they are unaware of existing resources or perceive that available resources do not sufficiently meet their needs. These faculty members described an understanding of the iterative process that is required for an effective design and explained that the development of their own technologies is frequently funded by

research grants. Some faculty indicated that occasionally this needed activity results in an improper allocation of funds and time.

“One or two more iterations of those and I will have it [CD with course information] in a reasonably decent form.”

-Faculty Member

Student Preferred Methods

Student survey respondents defined their preferred methods to learn how to use technology as exploring, experimenting, direct in-class instruction, and help from colleagues, friends, and family. Students defined these methods as effective: 82% of student survey respondents reported they are *usually* or *almost always* comfortable learning to use new technologies needed to complete their coursework or research.

Though students reported a high comfort level with learning how to use educational technologies, 83% of students agreed that they should be informed in advance of the tools and software that they will be required to use in their courses. Students explained that gaining this knowledge prior to the first day of class provides them an opportunity to review and develop their skills with the required technology. In the focus groups students suggested placing this information in the course description or course catalog.

“I think that in the course catalog it would be helpful to suggest what [technologies] you should have an understanding of, or what you will be using in the course, and to explain beforehand so that you can brush up before the course.”

-Undergraduate Student

“As far as big projects... it would be nice to know that you’re going to be required to have some knowledge of the Internet or PowerPoint so you are not scrambling to learn in two days.”

-Undergraduate Student

Though students are often learning technology independently through exploring or experimenting, students across all self-rated expertise levels prefer to learn how to use technology within the context of direct in-class instruction ($p < .006$). Only 3.8% of student survey respondents reported that they did not want to receive instruction on technology in the classroom.

Although this is the preferred context to learn how to use technology, only 13% of students reported *always* receiving adequate help from their instructors in using technologies to complete coursework they assign. To define what “adequate” instruction on technology is in the classroom, we asked students in focus groups to identify their preferred methods for technology integration.

Students described their preferred methods to be taught how to effectively use technology in the classroom similar to faculty: a smaller environment where they can receive instruction and help on a one-on-one basis. Students explicitly stated they would like to learn by having hands-on experiences while receiving visual and verbal prompts. They also expressed a desire to obtain a hand out with step-by-step instructions to use on their own time at their own pace.

This learning context was also indicated as preferred in the student survey. Students reported a partiality to learn how to use technology in-class by demonstrations (82%), step-by-step instruction in a computer lab (67%), and verbal instruction (58%).

“I like to learn technology in a lab on the computer showing us what we need to do step-by step. I want to receive a written copy of the instructions and then a first-hand experience.”

-Undergraduate Student

“For me it’s hard to focus in a huge class, I prefer a smaller setting where you receive one-on-one instruction.”

-Undergraduate Student

“Hands-on stuff really helped. Having a computer in front of you when being instructed is so important.”

-Undergraduate Student

Students’ self-rated expertise does impact how they want to learn about technology. Novice users prefer workshops ($p < .001$) where one-on-one help is available. Expert users prefer more independent modes of learning, including online computer tutorials ($p = .003$), books ($p < .001$), experimenting ($p < .001$), and email support ($p < .001$).

Unfortunately, students did not demonstrate an awareness of the present resources at the UW available to them to learn how to effectively use educational technologies. In result, students described a need for more resources, easier access to assistance on how to use technologies campus-wide, and increased instruction within the classroom.

“We need more information how to get help, more people that know what’s going on in the places where undergraduates are taking classes and need help.”

-Undergraduate Student

“Any method would have been better than no method!”

-Undergraduate Student

Faculty vs. Student Preferred Methods

Students and instructors at the University of Washington described a similar preferred context to learn technology: a more intimate environment with a computer at hand and help on a one-on-one basis available. However, when comparing faculty and student survey data there were some slight differences between each population's ideal method for learning how to use technology effectively.

Students were **less** likely than faculty to prefer workshops, books, experimenting, friends, phone, and local/technical/lab staff to learn about technology. See Table 4. Students were also less likely to not wish to learn than faculty. See Table 4. Students were **more** likely than faculty to favor online tutorials as a method of instruction to learn about technology, paralleling our findings that many students want to learn independently how to effectively use technology.

“Learn on your own basis.”

-Undergraduate Student

“The homework is pretty strictly learn on your own.”

-Undergraduate Student

Faculty and students with similar expertise levels desire similar modes of instruction. See Table 5. Faculty and students who perceive their expertise with computers to be advanced or expert are more likely to desire to learn about technology through online computer tutorials, books, journals, tutorials, exploring, and experimenting. In contrast, faculty and students who are novice or intermediate computer users prefer to learn about technology by attending workshops, receiving help from colleagues, friends, and family, calling telephone consultants, and accessing computer lab staff for assistance. See Table 5.

II. Creating a Blueprint

Regardless of a student's chosen discipline, all students expressed a desire to learn how to effectively use basic technologies while enrolled at the UW and to improve on their current self-rated expertise with technology by the time they graduate. This expected change necessitates creating a blueprint of the knowledge architecture that integrates technology across the various fields of study that comprise the UW community.

Drafting this plan was an intricate process. First, we defined students' current self-rated expertise, and how these self-perceptions varied across major, class, and gender. Subsequently, we determined students' desires for an increase in their expertise with technology by graduation. With this data, we developed a plan to integrate technology across the diverse curricula at the UW.

Students' Self-Rated Expertise

Within the student survey, respondents were asked to rate their ability to engage in various technical skills. They also rated their desired expertise level with these same technical skills by graduation on a scale: Novice "1", Intermediate "2", Advanced "3", and Expert "4". For each respondent, the overall mean of these skills was then calculated and termed a "self-rated Technology Proficiency Score" or TPS.

To validate the "Technology Proficiency Score" we compared students' overall self-rated expertise using computers with their composite TPS. Appropriately, these two variables were significantly related ($p < .001$). Students who rated themselves as expert with using computers had a higher mean rating on their current TPS ($M = 3.3$) than advanced users ($M = 2.6$), intermediate users ($M = 1.9$), and novices ($M = 1.0$), $F(3,536) = 205, p < .001$.

There were slight differences in students' self-rated computer expertise across subcolleges. No subcollege's mean of self-rated expertise was greater than advanced ($M > 3.0$) or less than intermediate ($M < 2.0$). See Table 6.

Freshmen had a lower mean rating of their current TPS ($M = 2.04$) than Sophomores ($M = 2.2$), Juniors ($M = 2.07$), Seniors ($M = 2.2$), Masters ($M = 2.2$) and Doctoral level students ($M = 2.4$), $F(5,512) = 2.74$, $p = .019$. However, Freshman and Sophomores expected to have a higher mean TPS at graduation ($M = 3.12$ and 3.16 respectively) than Juniors ($M = 2.89$), Seniors ($M = 2.83$), Masters ($M = 2.94$) and Doctoral level students ($M = 2.97$), $F(5,512) = 1.27$, $p = .015$. See Table 7. This data reinforces anecdotal evidence that younger students have high expectations to develop their technical skills upon entering the University.

The mean of students' current self-rated TPS skewed to the low side of intermediate ($M = 2.2$) However, upon graduation, students would like to rate all technical skills significantly higher ($M = 2.9$, $p < .001$). See Table 9. Once again, parallel to what would be expected, expert computer users had a higher desired mean rating of their TPS at graduation ($M = 3.7$) than advanced users ($M = 3.2$), intermediate users ($M = 2.7$), and novice users ($M = 2.2$), $F(3,536) = 73.2$, $p < .001$.

Students who rated their current ability to use a computer as novice or intermediate desired a greater increase in their technology proficiency by graduation (M novice increase = 1.2 , M intermediate increase = $.9$) than current advanced and expert users by graduation (M advanced increase = $.6$, M expert increase = $.4$). This data indicates that technology training for students should focus on the current novice and intermediate computer user, as they desire a greater increase in their proficiency by graduation than advanced or expert users.

Unsurprisingly, men rated their TPS higher than women both currently ($M = 2.5$ vs. 2.0), $p < .001$, and at graduation ($M = 3.1$ vs. 2.8), $p < .001$. Though these differences exist, it should be noted that over 50% of student survey respondents confirmed that by graduation they would like to perceive themselves as advanced or expert at all basic technical skills investigated in the student survey. See Table 8.

Often students have never engaged in the technical tasks that they reported a desire to be advanced or expert at by graduation. For example, 41% of students reported currently never having tried to create Web sites, but 47% said they should have advanced or expert skills at it by graduation! For a direct comparison of students' current mean self-rated expertise with each technical skill versus means of desired self-rated expertise by graduation. See Table 9.

With only 7% of the student survey respondents reporting that educational technology is used *always* or *almost always* consistently throughout the UW, and their desire to learn new technologies and improve on their present technical skills by graduation, we drafted a blueprint that incorporates a curriculum plan integrating educational technologies throughout the diverse University community.

Curriculum Planning

Basic Technology Course

Fifty-seven percent of students agreed that the UW should provide more opportunities for them to use technology in their coursework. When we inquired in student focus groups how they would like to receive these opportunities to use technology, they suggested a required freshman course. Students recognized that their instructors have time constraints to teach technical skills within the context of their courses. In response, they described a solution: the University should offer a course designed specifically to develop their skills with technology.

Students also stated that by requiring a basic technology course they are provided an opportunity to develop their ability to effectively and efficiently use required technologies in their academic careers. Furthermore, students described this course as a method to alleviate their fears of incompetence to use technologies after graduation.

“It would be nice to have a class required. It’s the best alternative to taking up class time to bring people up to speed [to use technology].”

-Undergraduate Student

These findings were investigated further in the student survey: we asked respondents to report their level of agreement that the UW should require a course designed to build basic technology skills. Unfortunately, the data were inconclusive. Student responses were evenly distributed. See Table 10.

Faculty focus group participants were also asked if the UW should require a basic technology course for incoming students. Faculty were not convinced that a technology course should be required, but several suggested teaching basic skills during a mandatory orientation seminar. They recognized that students need to learn these technical skills but described an inability to teach them in their courses. Instructors also explained that students should acquire advanced and expert technical skills on their own time, through such venues as free UWired workshops.

A solution proposed by faculty to guarantee students’ abilities to use required technologies was to administer a campus-wide proficiency exam designed to evaluate students’ basic technical skills. Faculty suggested that those students who do not perform at an acceptable level on this test be required to enroll in a course teaching them those technical skills required of them during their academic careers.

Building Blocks

Students described a preference to learn technology by repetition, first developing fundamental skills, then building on this knowledge to complete more advanced tasks using technology. They explained that they would like their homework and projects that require technology to build upon each other throughout the quarter. As one focus group

explained, if students are expected to create their own Web sites, faculty may assign homework throughout the course to complete the process step-by-step.

“It would have been nice to be assigned really simple homework assignments that dealt with those programs so that we can learn step-by-step.”

-Undergraduate Student

“Start the project early in the quarter and have it so that each week you build on what you did the week before.”

-Undergraduate Student

III. Framing the new structure

Reducing stressed points

To reinforce the new knowledge architecture we identified the stressed points in the structure and redesigned these areas to increase the durability of the growing construct. This strength was achieved through defining faculty and student discrepancies regarding educational technologies and listening to their recommendations on how to respond to these differences across the population. Issues identified as needing to be addressed included faculty and student self-rated expertise and student desires for technology to be integrated into their courses.

Faculty vs. Student Self-Rated Expertise

Student survey respondents rated their computer expertise slightly higher ($M=2.5$) than faculty rated themselves ($M=2.4$), $t(2768) = 2.04$, $p = .04$. Furthermore, there was no interaction between students and faculty self-rated expertise and department/major. Students tended to rate themselves more highly than faculty regardless of their department or major.

Not only did students rate themselves highly regarding their expertise with computers, but they perceived themselves to be proficient using technology. Forty percent of student survey respondents reported themselves to *always* be proficient at using educational technology to complete their coursework, and another 46% stated they are *usually* proficient. Faculty are aware of students' proficiency with technologies, only 12% of faculty survey respondents reported concerns that their students are not proficient with information technology in coursework.

"It seems to me most students are very technologically savvy and even the ones that aren't, are very quickly learning from their peers when they get here."

-Faculty Member

Faculty did not perceive their own expertise with technology to match or exceed student abilities. The mean of faculty current self-rated computer expertise was slightly above intermediate (M = 2.4, n = 1831). Students agreed that faculty members are not as proficient with technology as themselves: only 16% of students stated that faculty are always proficient with the educational technologies they are assigning, and only 13% of students believe that faculty are always proficient with the educational technologies they are using for communication and presentations in their teaching.

"I agree that technology frequently gets in the way of thinking."

-Faculty Member

Faculty Training

Both faculty and students suggested resolving this perceived proficiency gap by training faculty how to use, develop, and integrate educational technologies into curricula effectively.

Faculty stated that technology "is coming no matter what" and articulated the belief that the University should support them to adopt technology into their

teaching practices by providing training. Students agreed: the University needs to support faculty by providing training focused on enhancing their courses. This training, as defined by faculty and students, includes teaching effective uses of educational technology, increasing awareness of the tools available, and informing faculty of the potential learning benefits that can result from technology use in the classroom.

“Train them – some of them can’t even log on to the machines in the class rooms. It takes 15 minutes into your 50-minute class. It’s distracting.” (Authors’ emphasis.)

-Undergraduate Student

“[Professors] don’t have to be on the cutting edge or the leading edge, but they’re not even partway there. That’s the problem, in many cases they’re just not aware of the technology available.”

-Undergraduate Student

“A professor will come into a classroom used to exclusively using his overhead projector, then he tries to figure out how to use PowerPoint, how to make PowerPoint slides – he’s still in the mindset of his overhead projector. That’s one of the biggest problems I’ve seen. If we provide training for the professors to use this technology in the classroom, I think it would benefit everybody.” (Authors’ emphasis.)

-Undergraduate Student

“I have one instructor that tried to use the cordless mouse to advance the slides and he could never do it, yet he tried every single class. It was very distracting, he would get really mad... it was terrible.” (Authors’ emphasis.)

-Undergraduate Student

“Do you feel you get more out of a course if they use technology?” “Yeah.” “If the instructor knows how to use it.”

-Undergraduate Students

“Faculty are letting technology pass them by. They have been so much into academia that are just not staying in tune with things and being aware.”

-Undergraduate Student

Students explained that when faculty are not proficient with the technology they are using in their classes that it detracts from their learning. Therefore, they suggested faculty not integrate technology into their classroom until they have been trained how to effectively use technologies, are confident with their ability to use the tools, and are convinced that it enhances their courses.

“Don’t force it on them, because that will definitely not enhance student learning! Nothing is worse than an angry professor. If they are bitter about something they have to do in their class, you’re not going to get their best.”

-Undergraduate Student

“The professor comes in and they have this attitude, ‘oh, this computer. I don’t know what’s going on here.’”

-Undergraduate Student

“They don’t seem confident with it and they get distracted by the technology. It’s like faculty are using technology because they were told it’s great and it helps learning and they’re bitter about it. If it makes them uncomfortable then don’t use it.”

-Undergraduate Student

Faculty vs. Student Frequency of Technology Use

Faculty and students are using different technologies for their work at the UW. There were significant differences between faculty and student uses of spreadsheets, publishing, authoring/editing, browsers, calendars, and Catalyst Web-based tools ($p < .003$). See Table 11. Students are using Web browsers and Catalyst tools significantly more than faculty ($p < .001$), and faculty are using spreadsheets significantly more than students ($p < .001$).

Though significant differences existed between what technologies are used by faculty and students, both groups' self-rated expertise was significantly related to their frequency of technology use ($p < .001$). Students and faculty who rated themselves as a novice computer user are using fewer technologies for their work at the University than intermediate, advanced and expert computer users. As perceived ability to use a computer increases, so do the number of technologies faculty and students use on a regular basis (regular basis = mean of once a month or more, $M \geq 2.0$). See Tables 12 and 13 for faculty and student technology use based on expertise levels.

Student Training/Information Literacy

Information literacy is a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information (American Library Association, 2000). It is an intellectual framework for understanding, finding, evaluating, and using information. These activities may be accomplished through critical discernment and reasoning (American Library Association, 2000).

Students reported in the survey and focus groups that they have highly developed information literacy skills. Only .1% of student survey respondents reported that they have *never* tried to find scholarly information and resources using a computer. Not only are students using the computer to find information, but a

surprising 63% of student survey respondents reported they were advanced or expert at finding scholarly information. Over 91% of students would like by the time they graduate to perceive their skills to use a computer as advanced or expert. More importantly, 90% of students also reported that currently they are intermediate or better at critically evaluating the information they find.

Faculty disagreed strongly! They expressed great concerns that their students are able to use the computer to find information, but their ability to evaluate the located information is considerably less developed than their Web skills.

“I am sort of horrified by how technologically able they are and how ignorant they are of other, more cogitative, ruminative ways of study. I think they want to get it quick and they want to see it and have it all make sense, be laid out. The kind of problem-solving, such as weighing personal opinion, is lost. The Web is just so fraught with horrible information.”

-Faculty Member

Reinforcing pillars of strength

To ensure that the construction of this new knowledge architecture is solid and durable, we defined the intersections between faculty and students regarding their expectations and uses of technology. We used these connecting points of data as the pillars of strength to reinforce the structure.

Assessing Student Expectations

In some cases, students have weaker skills or a lower level of technology proficiency. Students stated that professors assume they are knowledgeable and proficient with required technologies. They are frustrated with these assumptions, and urged instructors to assess rather than assume their ability to effectively use technology. Many students

suggested that faculty administer a survey at the beginning of each quarter for instructors to explore their experiences with technologies, their abilities, and their comfort level with educational technology.

“Professors walk in assuming that since they know how to use technology it’s going to be easy for the kids to know... a lot times this is not the case.”

-Undergraduate Student

Parallel to students’ articulated beliefs, instructors stated that they assume their students are prepared to use required technologies for learning. However, instructors explained they are unsure of how to recognize students with weaker skills, since they may be reluctant to identify themselves.

“If we could find the person in the freshman class that doesn’t know how to browse the Internet I think we could do a TV special about that person and find out how it happened.”

-Faculty Member

“I’m making a lot of assumptions these days with regard to technology and the background knowledge that students have.”

-Faculty Member

Faculty suggested that the University conduct a student survey not only exploring their abilities to use technology, but investigate their expectations of technology use in the classroom. By conducting a survey as a formal assessment, faculty expressed a hope that coworkers and department chairs will gain a greater awareness of the minimum expectations students have regarding technology use at the University of Washington. With this data faculty hope to encourage the University’s leadership to support educational technology adoption.

“UW leadership and department chairs could be informed of whether students ask for it or not... what do freshmen coming into the University expect of us?”

Whether you want to do it or not, here’s what students are going to expect as normal, here’s what they’re going to probably think you’re from somewhere in the Ice Age if you don’t know how to do.” (Authors’ emphasis.)

-Faculty Member

“My department chair doesn’t necessarily know what the students are going to expect – that’s just sort of my job.”

-Faculty Member

Faculty described two methods they implement to gauge their students’ abilities to use educational technologies effectively. The first method discussed was anecdotal evidence. Faculty explained they integrate technology according to informal comments and impressions provided by students. Secondly, instructors reported administering Web-based surveys on a class-by-class basis to assess students’ abilities to use technology effectively.

University Libraries

Faculty described the UW Libraries as having adapted extremely well to the influx of new media and new methods for working with information. Some faculty stated that students’ abilities to access information within online library resources are significantly surpassing their ability to use the libraries’ physical facilities.

“Students have a much more advanced knowledge of technology and a much lower knowledge of how the library works.”

-Faculty Member

“Using the libraries is a basic tool that all students here should know how to use in their time here. We need to make sure that they are all up to speed on how to use the technological aspects of the library.”

-Faculty Member

“UWired was an excellent idea that brought together the library and the(Computing & Communications) people. It actually made a difference around here, and I think it continues to.”

-Faculty Member

“I can do almost everything I want from my desk right now or even from home. The library made a wonderful transition.”

-Faculty Member

Students also described an appreciation for online library resources. They stated they are utilizing these electronic resources frequently and articulated an appreciation for the convenience of accessing library information and resources electronically. Students also explained that they physically visit the library less often than they use online library resources.

“You don’t have to go to the library, you can go to the computer and do all that stuff.”

-Undergraduate Student

Desires for Technology Integration

Students shared the belief that a university education should include the use *and* instruction of technologies employed widely among academic and non-academic settings. They stated that to remain competitive in their future careers they need instruction to develop technical skills.

“My goal is to take this knowledge and take it out in the world that we’re living in and if you totally avoid technology within the university, you get out here to the world and suddenly you’re not getting matched up with it.”

-Undergraduate Student

However, students stated that when educational technology is integrated into their coursework they are not always instructed how to effectively use the required tools.

“I’m graduating now and I’m pretty upset with how little I know about technology, I really wish that I was more confident and knew more after four years of my education at a university. A lot of it is probably independent work that you can do to learn it, but we’re busy enough with jobs and school that I just really haven’t felt like I had the time to actually independently learn it...it would have been really helpful to have not been expected to know it but to have actually been taught it.”

-Undergraduate Student

Faculty recognized student desires for technology integration and instruction in their academic careers and agreed that technology adoption is student driven.

“Students are pushing, they’re familiar with the technology.”

-Faculty Member

“This is student driven: their expectation of how they want the material delivered, how they best receive material that’s delivered. Rather than just a straight-up lecture, they like the technology. Many of them learn better when visually looking at pictures.”

-Faculty Member

Though faculty did report an understanding of student expectations of technology in their courses, they explained that they are not integrating many technologies into their classes due to several barriers.

IV. Upgrading the electrical system

Barriers to Technology Adoption

Faculty defined many barriers to technology adoption that have contributed to this discrepancy between student desires to use and learn educational technology and actual faculty integration of the tools. Therefore, to successfully remodel the present knowledge architecture, the existing electrical system must be upgraded to redirect the energy flow of the University to avoid these barriers.

In the faculty survey on educational technology respondents indicated the three most prominent barriers to technology adoption as: lack of skills (48%), lack of time (54%), and lack of incentives (31%). In the qualitative portion of this study, we investigated these findings further, identified additional barriers to technology adoption, and had faculty articulate ways in which we can redirect the energy of the new knowledge architecture to overcome these barriers.

Lack of Skills

One of the greatest barriers discussed by instructors to adopting technology is their perceived self-efficacy with the tools. Faculty in the focus groups stated their students' skills far surpass their own and expressed a desire to close this ability gap. One faculty member shared this concept explicitly:

"I'm feeling like a Pony Express rider when the telegraph came along."

-Faculty Member

However, some instructors stated that the effort required to develop their skills is a burden, especially when they have difficulty seeing the benefits of implementing technology in the classroom.

“Not knowing the payoff, it’s frustrating, is this really going to work? I’m going to put in all this work and then is it going to work? I don’t know how much the investment is worth.”

-Faculty Member

Lack of Time

Another critical barrier defined by faculty is their inability to make the significant time commitment that has marked the adoption of technology into teaching. They expressed great relief when they are able to delegate technology-related tasks to the libraries, departmental Web managers, Classroom Support Services, or other similar technical support staff. Faculty acknowledged that their departments are willing to pay for this support, up to a certain point. By giving an unfamiliar technology task to someone else, faculty described increased time to "focus on the content" of their courses.

“Sometimes I feel that with the demand of everything else we’re supposed to do that the push to use technology to improve learning can be one more thing that can be burdensome.”

-Faculty Member

“I don’t have time to set up everything, take it down, and go to the next classroom and set it up again.”

-Faculty Member

“[My Web developer] must work a zillion hours a week. He loves this stuff!”

-Faculty Member

Lack of Incentives

Faculty described the lack of incentives as a barrier to technology adoption. Therefore, when rewiring the knowledge architecture, the energy flow of the University needs to be directed towards greater resources that can act as incentives for technology adoption.

Release time was a common incentive described by faculty as desirable to influence their adoption of technology into their teaching. Instructors described release time as an opportunity to thoughtfully "technologize" their courses. However, most instructors recognized that release time is unrealistic considering their ongoing research and grant-funded responsibilities. Alternative suggestions articulated by faculty to assist them in embracing educational technologies included merit pay and/or additional TA's trained specifically in the tasks of working with educational technology. The University must also consider seriously what role technology plays in the tenure process.

“And the money! Show me the money.”

-Faculty Member

In response to the diverse technical abilities and barriers to communication among faculty regarding technology, it was suggested in focus groups to encourage the University community at large to recognize effective technology development and use. One particular mode of recognition defined was the creation of publicly announced awards in their fields and departments.

Lack of Equipment

Instructors described another barrier to technology adoption: a lack of equipment available to them across the University. Faculty described frustrations with the lack of technology in their teaching environment, and stated that while the newer buildings are a step in the right direction, the majority of classrooms are not adequately furnished, even

with basic tools such as computers. Forty-two percent of faculty survey respondents reported they have never used a computer in the classroom to do their work.

“I think at a minimum the University needs to provide a high functioning laptop to every faculty person, and the departments with enough LC data projectors so they can be used in every class.”

-Faculty Member

In response to the present technologies available to them in classrooms, faculty explained they are transporting and setting up their own equipment, either themselves or by paying Classroom Support Services. Faculty elaborated that this activity is a waste of time and money.

Faculty reported that the presentation technology they currently use most frequently is overhead transparencies. Twenty-three percent are using them 1-2 times per week and an additional 13% are using them everyday. Specific tools defined by faculty as needed in the classroom were: projector/focus machine, laptop, Internet access for students, and a podium with advanced technological capabilities. When faculty were asked in the survey to identify what technology they would like to have available in the classroom, (checking all that applied) 81% of faculty would like overhead projectors (for transparencies), 55% would like VCR's, 54% would like technologically advanced podiums, 52% would like a multimedia projector, and 43% would like a slide projector.

“Right now most of our small classrooms are 40's, 50's, 60's, and really not well adapted to allowing us to do the kind of things that we have current technology to do, so the rooms themselves sometimes are as much of an impediment as anything else.”

-Faculty Member

“It seems like a minimum condition of an employer, for example, the University, is to provide the relevant technology for us to do our jobs.”

-Faculty Member

Culture of Educational Technology

“I don’t really feel so much that I have time to develop it and I don’t feel very supported.”

-Faculty Member

Another barrier that needs to be addressed in the new electrical system of the knowledge structure is the culture and perceived lack of support surrounding educational technology adoption. Faculty stated a belief that the University’s present culture of appropriate educational technology use is still in its nascent form. Nearly one in four faculty survey respondents reported that the University could improve the support presently being provided for technology adoption.

Faculty expressed a concern that they are not at the same level of integration as some of their colleagues, and described communication between instructors regarding technology to be strained in result of the wide variations of technology use and abilities. These pressures draw energy from the already strained culture of educational technology adoption at the UW.

Instructors described a need for the University to foster an environment where online journals and resources are considered reputable among the community. Faculty also reported in the survey that they would like Web communication to become more widely used and recognized as a sound mode of communications across the UW. Approximately 25% of respondents shared that they would *very much* like to use the Web to collaborate with people at the UW and around the world.

“You can’t just change the cultural sense of what counts as important here, but it’s got to change over time.”

-Faculty Member

“[Publishing in] online journals is not considered legitimate.”

-Faculty Member

DISCUSSION

I. Overview of Opportunities and Findings

Until recently, anecdotal evidence had been one of the only ways to understand our community's expertise, desires, barriers, and opportunities for using educational technology. The purpose of this project was to make an institution-wide assessment of educational technology at the University of Washington that incorporated qualitative *and* quantitative data. In this discussion, PETTT will use the study findings to facilitate discussion for improving existing tools and strategies. PETTT hopes this work also will identify gaps in training, development, and infrastructure regarding educational technology.

The findings reported within the development of this knowledge architecture are compelling. Anecdotal beliefs that have influenced the decision-making process of technology integration into our community are both confirmed and denied. Dramatic differences between previous perceptions of technology use here at the University of Washington, versus the perceived reality of faculty and students, are illuminated.

We found that students and faculty agree on what technologies they use in the service of education at the University of Washington: course Web sites, PowerPoint, discussion boards, email, electronic reserves, and using the Web for research. They also agree that some applications of technology are not as useful to them as others.

In many cases, faculty and students perceive each other to have vastly different technology opportunities. Faculty perceive pressure from their students to incorporate technology into teaching, but they feel they lack the time, skills, and equipment to do it effectively. Many faculty are doing what they can to integrate technology into their curricula, but struggle with wanting to do more for their students, and do it effectively. They express strong concerns that their students' abilities to evaluate information critically are considerably less-developed than their Web-searching skills.

While faculty may perceive a dearth of opportunities, students perceive a wealth of opportunities for the University to fill. Students have high expectations for the development of their technical skills by graduation and think the University should be largely responsible for providing training. Students think that faculty need training to integrate technology successfully into their curricula.

Faculty and students are closer together in wants and needs with educational technology than they think. Faculty perceive pressure from their students, peers, and the University to use technology. They recognize their barriers and want appropriate technology training that maximizes their skills and the educational experiences of their students. Students understand their own strengths and weaknesses, know what they want from their UW experience in terms of technology, and are comfortable learning new technologies when needed.

The remainder of this discussion will refine the details of these findings. In each section we will distill the research to reveal what we now know about educational technology at the University of Washington and make scaled recommendations, of minimal to complex involvement, for remodeling its knowledge architecture. PETTT's recommendations can serve as a starting point for conversation, providing the research necessary to make informed decisions about resource allocation and future technology use at the University of Washington.

II. Taking Advantage of the Opportunities

This report illuminates many opportunities to facilitate a smooth, appropriate adoption of educational technology. By engaging in strategies to respond to these identified opportunities, the University of Washington’s new knowledge architecture can be constructed. These strategies include enhancing faculty and student’s skills with technology, integrating desired technologies into diverse curricula, enriching the culture of educational technology, and supporting the culture of technology adoption.

Enhancing Faculty and Students’ Technology Skills

Enhancing Skills of UW Faculty

Faculty and students described a desire for the University to support technology adoption through training faculty how to effectively develop and integrate educational technologies into their courses. Faculty also expressed a preference to be taught how to effectively use educational technologies in a manner that does not divorce pedagogy from their technical training.

As a result, the University may wish to consider several strategies to train faculty not only in the technical aspects of technology but to assist instructors in the alignment of the educational technologies with their pedagogical objectives. These strategies will promote an integration of technology across the community that will innovatively enhance teaching practices while meeting faculty desired training needs.

Enhancing Skills - Faculty

Minimal	Intermediate	Complex
Publicizing resources	Workshops	Technical TA’s
Delegation	Consultations	Online tutorials

Table D1-a: Recommended activities for enhancing skills of the UW Faculty

Publicizing Resources

Faculty did not always describe an awareness of the present resources available to them to learn how to use technology. Therefore, we recommend making those resources that exist (i.e. Catalyst, Human Resources professional development, etc.) more widely publicized and more easily accessible. Particular venues to publicize these resources include “The Daily”, “UWeek”, and “On-Tech News”. Events calendars and special events also may prove useful opportunities for publicizing available resources.

Delegation

A large population of faculty did not express an interest in learning how to use technology. These individuals find great relief in delegating technology related tasks to others. For this group of instructors, we advocate raising awareness of the current support available to them from the libraries, departmental Web managers, and Classroom Support Services. Individuals from these groups can be encouraged to provide introductory training and demonstrations of technology use to their faculty colleagues when appropriate.

Workshops

Technology workshops were considered by faculty as an effective method to learn about educational technology if they were targeted for novice and intermediate computer users, covering the more basic, introductory skills. Particular tools identified by faculty as desirable to learn basic skills and receive pedagogical tips to effectively integrate into their courses included PowerPoint, Discussion Boards, and email listserv’s. Considering this faculty desire, the University may wish to develop workshops addressing the pedagogical and technical issues

surrounding the use of these technologies. This training should also include how they can enhance students' ability to make the most of online communication.

Consultations

The development of a consultation service that meets instructors' needs to be trained on the technical and pedagogical aspects of educational technologies may be helpful to the community. PETTT has and will continue to respond to these findings by successfully collaborating with Catalyst, a group that designs and develops educational technologies on the University of Washington's campus. Together we have enhanced the consultation service that affords faculty guidance on effective development of educational technologies to meet their academic goals. Within these one-on-one consultations faculty receive the technical assistance necessary to learn how to use the tools. This collaboration has proved to be an efficient manner to train faculty in the design, development, and implementation of technologies into their courses.

Technical T.A.'s

The University may wish to consider the re-designation of a position to relieve faculty of the perceived burden of learning how to use technology: the Technical Teaching Assistant. These trained individuals could help faculty overcome the challenges of technology adoption, acting not only as a resource for faculty, but as a means to train students how to effectively use technologies in smaller sections of the courses. Technical T.A.'s should have special skills in teaching with technology.

Online tutorials

A scalable strategy to train faculty how to effectively integrate educational technology into their curricula, teaching them both basic skills and pedagogical

strategies, is the development of online tutorials. These tutorials could address issues surrounding widely used educational technologies, provide examples of effective integration of technology into various curricula, and facilitate faculty to consider the potential benefits to technology integration into their courses.

Enhancing Skills of UW Students

Dynamic findings were borne out of the student Technology Proficiency Score data. This score represented an average of student self-rated expertise on a range of technical tasks. However, some skills listed required a more advanced proficiency than others. Ideally, when calculating the TPS each skill investigated would have been weighted based on the difficulty of the task. Subsequently this adjustment would provide a more accurate reflection of a students' proficiency with technology.

Despite the fact that the TPS was not calculated with weighted ratios, students overall rating of their computer expertise was significantly correlated with their current composite TPS. This correlation helps validate that the TPS is an accurate indicator of their proficiency with technology. With this considered, there are some interesting findings within this set of data.

Students are expecting a significant increase in their TPS by graduation. The majority of students expect to consider their abilities to use technology to be at least advanced, if not expert before leaving the academic environment and entering careers. The University has an opportunity to respond to these student desires by integrating technology more widely across the community and enhancing students' technical skills through training strategies.

When developing these strategies, the significant differences between the various classes and their current and expected TPS by graduation may be valuable to consider. As expected, Freshmen and Sophomores rated their current TPS lower than Juniors, Seniors, Masters, and Doctoral level students. However, by graduation, Freshman and

Sophomores desire significantly higher scores than students of other ranks. This may reflect a phenomenon that incoming students have increasingly high expectations of technology integration into their higher education curricula.

As time moves forward technology will continue to inundate our society until it has saturated all environments. Student expectations for a high TPS by graduation demonstrate that the post-secondary environment is not excluded from these rapid changes and increased technology integration. Furthermore, these findings support the notion that the community itself is the driving force to engage in strategies designed to construct the knowledge architecture of the future and the need to enhance students' technical skills.

Enhancing Skills - Students

Minimal	Intermediate	Complex
Publicizing resources	Workshops Orientation seminars	Assessing students' technology proficiency

Table D1-b: Recommended activities for enhancing skills of UW students

Publicizing Available Resources

Students often were unaware of the resources designed to develop their technical abilities. Informing students of these resources in general orientation and publications that target students could respond to this problem.

Workshops

Students described their preferred method to learn technology as direct in-class instruction, demonstrations, and verbal instructions in a step-by-step manner. They also prefer training to be in a computer lab where they can have a “hands-on” experience while learning how to effectively use technology.

Considering the barriers faculty described to technology adoption in the classroom, this student desire may not easily be met. In result, the University may wish to consider continuing to support student workshops covering technical skills, widely publicizing these opportunities, and expanding on this resource by increasing the number and availability of these workshops. Though this instruction how to effectively use technology is not within the context of a course, it is the best approximation of how to teach students within their desired environment.

There was a high correlation between students' self-rated expertise and their learning preference for technology. Advanced and expert users are learning how to use technology independently. However, novice and intermediate users prefer to learn technology in workshops. Therefore, the university may wish to consider creating more workshops with basic, novice-level content.

Orientation Seminars

The community defined a need to train students how to use technology. However, the strategies investigated in this report to enhance students' technical skills elicited inconclusive data. A required basic technology course was not widely embraced by the community.

The University may want to consider providing orientation seminars as a strategy to respond to the community's desire to train students to use technology. These seminars could include a brief overview of the technologies students are expected to be proficient with during their academic careers. At the conclusion of this seminar it could be recommended that those students who are not comfortable with the skills discussed enroll in a basic technology course to acquire these skills.

Assessing students' technology proficiency

To enhance students' skills to use technology by graduation, the University may wish to consider administering a technology proficiency exam to all incoming students. This will afford the institution an opportunity to assess students' baseline of abilities to use technology, gauge what tools students are able to use, and determine how proficient they are with each of them.

The exam as an assessment strategy may aim to explore not only students' technical abilities with tools, but determine how developed students' information literacy skills are. This report elucidates a discrepancy between students' perceived ability to critically evaluate information and faculty's critique of students' ability to engage in this task.

By administering a proficiency exam exploring students' actual level of information literacy this discrepancy can be fully understood. If students demonstrate a low proficiency with their information literacy skills, the University may then wish to consider integrating information literacy skills training into students' academic experiences.

Faculty also described a concern that their students are widely plagiarizing when using online resources. By assessing students understanding of plagiarism concepts within the technology proficiency exam, the institution can determine if there is a need for further instruction on general academic research techniques.

UW Community Expertise

This technology report provides an opportunity for the University community to be educated how faculty and students perceive their peers and one another's technical expertise.

Faculty described using anecdotal evidence to assess their students' expertise with technology and explained they are frequently assuming student's proficiency with technology to be advanced or expert, surpassing their own expertise with technology. However, this report has identified a large gap between these faculty perceptions and actual student self-rated proficiency with technology. Our data reveals that students rate their proficiency with technology only *slightly* higher than faculty and this phenomenon is maintained across departments and majors.

Self-rated measures have limitations which may contribute to faculty and students perceiving their abilities to use technology equivocally. Faculty and students' self-rated expertise is a response based on perceptions, their individual opinions based on life experiences. In result, there is no uniform definition as to what a novice, intermediate, advanced, or expert computer is: faculty and students may define a novice or expert computer user dramatically different. For example, using basic or pervasive technologies like the Internet may inflate an individuals' perception of their technical ability. Or individuals with higher skills may rate their expertise lower because they have a more comprehensive understanding of advanced technologies. Similarly, those individuals with a lower expertise level may in fact perceive their abilities to be higher in result of not understanding the complexity of the technologies they claim to be proficient at using.

There is no definitive answer to the problems elicited by using this measure of self-rated expertise. However, to assist in determining the difference between the two populations' definitions of what a novice, intermediate, advanced, or expert user is, we defined faculty and students' preferred methods of technology instruction based on their self-rated expertise.

Faculty and students who rated their expertise similarly described similar preferences for modes of instruction on technology. Those novice and intermediate users prefer to learn technology within a context where one-on-one assistance is easily accessible, such as

workshops, help from colleagues, friends, and family, calling telephone consultants, and accessing computer lab staff for assistance. In contrast, the advanced and expert users prefer modes of instruction that are more independent.

These similarities among self-rated expertise and their preferred modes of instruction suggest that students and faculty are in fact over-generalizing each other's technical ability. Both faculty and students desire to have technology integrated into the community, are looking to the University structure for the support to adopt the technology, equally desire to be trained how to use technology effectively, and in fact possess similar technical abilities.

Technology Integration

Incorporating technology into the educational experience happens at different rates, with varying levels of skill, and is dependent upon a number of factors, including pre-existing use, expectation, and desire. Individuals and institutions have attempted to create models and rubrics to evaluate the degree to which technology has been integrated into a course. For example, at the 2000 Annual Conference of the American Educational Research Association, Brigham Young University, researchers described a qualitative analysis of situated Web-based instruction. They rated the integration of Web-based materials into coursework on a scale of 0 (no Web use) to 5 (immersive environment) (Harmon & Jones, 1999) and found that participation with Web-based materials correlated positively with course satisfaction. While we cannot achieve that degree of specificity with our data, we are able to recommend a scale of technology integration that relates directly to faculty and student desires and uses. See Table D-2.

Level 1	Email, word processing, the Web, databases or spreadsheets, PowerPoint
Level 2	Course Web sites, email lists of students
Level 3	Discussion boards, electronic reserves, video clips
Level 4	Simulations, data visualization or mathematics software, statistical analysis software, 3-D modeling, software development tools, videoconferencing

Table D-2: Levels of technology integration at the UW

In surveys and focus groups, faculty clearly indicate which technology skills they think students need to successfully complete their coursework and be competent with by the time they graduate: Email, word processing, the Web, and databases or spreadsheets. Faculty and students alike report using these technologies extensively. PowerPoint also emerged as an accepted standard in the classroom. We find these technologies comprise the baseline for technological skill at the UW. We will term this combination of uses Level 1 for technology integration.

Unsurprisingly, faculty and students identify course Web site components at the next level of technology integration. With the advent of visual Web editing software, the skills required to create and maintain course Web sites are far fewer and simpler than just a few years ago. Even though there is enormous possible variation in Web site content and complexity, one can create a basic Web site with little more than the baseline skills described previously. In addition, over half of students would like their instructors to use email lists of students. We will term Level 2 integration as the creation and maintenance of a static course Web site, the use of email lists of students, and all technologies from Level 1. Course Web site components are described in detail in the section defining educational technologies from this study.

Additionally, over half of faculty would like to use discussion boards, electronic reserves, and video clips if support and services could be obtained easily. Students would like

their instructors to use these technologies, many of which can be used in conjunction with, or as enhancements to, course Web sites. Level 3, therefore, represents Level 2 with the addition of discussion boards, electronic reserves, and video clips.

At the highest level of technology integration, Level 4, some combination of technologies from the previous levels is included, with the addition of task-specific, specialized software. Examples of these technologies include: simulations, data visualization or mathematics software, statistical analysis software, 3-D modeling, software development tools, and videoconferencing.

This scale is a fluid representation of technology integration at the UW. It is intended to guide administrators, faculty, and students to a common understanding of the degree to which technology is embedded in UW course curricula, according to faculty and student expectations, perceptions, and use.

Communicating the Level of Technology Integration

This study did not investigate the existing pathways by which administrators, faculty, staff, and students communicate their needs and interests regarding educational technology. Nonetheless, it is important to note that the integration of technology into a curriculum necessitates clear communication among all involved UW community members.

Students did not claim a high level of expertise in all technologies, but they expressed a willingness to learn those technologies required for their coursework, provided they are given sufficient advanced notice. One solution may be to include in the course catalog a list of required technologies for each course. Alternatively, such a list could appear on a course Web site and simply be linked to from the course catalog. This early communication of the level of technology integration into a course can assist in the smooth integration of educational technologies for students and faculty.

In the next section, we will look in more detail at how the UW community defines educational technology and what opportunities the University community has for appropriate, scaled increases in technology use.

Defined Technologies

“Educational technology” has no universal definition: it is a complex mix of hardware and software instances embedded in various educational contexts. This report outlines the University of Washington’s definition, addressing those tools that are presently used or are desired to be intertwined intimately into the daily lives of students and faculty.

The definition of educational technology was similar among faculty and students. Unfortunately, factor analyses were unsuccessful at grouping the investigated technologies into categories by skill level. There was an inability to statistically categorize technologies using two different matrixes and performing three rotations within each.

In response to this failed factor analysis, technologies investigated in the surveys were grouped by comparing student and faculty self-rated expertise with frequency of technology use. Technologies were grouped under an expertise level if the mean frequency of use of the tool was reported by faculty and students to be once a month or more. It was hypothesized that those technologies requiring a more advanced skill level would be more frequently used by faculty and students who considered their expertise to be of an advanced or expert status.

Our hypothesis proved true, Tables 12 and 13 provide lists of the remarkable similarities between the two populations’ expertise level and frequency of use of various technologies. This technology grouping assisted in defining educational technology among our community and categorizing technologies based on the skill level required to effectively use them. The novice faculty member is frequently using similar technologies

to that of the novice student. Only calendar/scheduling software, publishing software, and Web editors were used at significantly different frequencies among faculty and student expertise levels.

Faculty and students with similar self-rated expertise levels defined educational technologies on our campus similarly, including: course Web sites, PowerPoint, discussion boards, email, electronic reserves, and using the Web for research. With the interest of continuing to support these desired technologies into the knowledge architecture of the future, we identified strategies to improve the design and interfaces of the tools to meet teacher and learner needs, and to define points of training for faculty to effectively implement these tools into the classroom.

Course Web sites

UW students expressed their desire to have the University require all courses to use a standardized Web site; however, faculty may not be aware of how highly students desire course Web sites. As Table 1 reflects, students rated online materials provided on course Web sites as significantly more important than faculty rated them.

Though faculty rated these resources as less important, a large number of faculty survey respondents expressed a desire to use course Web sites if greater support and services were available. This data was confirmed in our qualitative work: faculty want to use course Web sites but expressed challenges and frustrations with their creation and maintenance.

In result, the University may wish to consider strategies to support faculty in the adoption of course Web sites through the development and dissemination of various tools such as SimpleSite and MyUW.

SimpleSite

SimpleSite, a tool developed by Catalyst, in partnership with PETTT and Computing & Communications, is a strategy to assist faculty in the development of a course Web site. This Web-based tool uses a standardized interface and facilitates easy maintenance of course Web sites. The use of SimpleSite as a strategy may facilitate a greater adoption of course Web sites within the University by simplifying the process of Web site creation for faculty.

Web developers of SimpleSite can build this interface to meet student needs by integrating Web site components that have been identified as desirable by students in this report. Online resources described as valuable by students included: course syllabi, lecture notes, anonymous feedback, homework solutions, grades/grading criteria, discussion boards, links to course reserves, and links to undergraduate research opportunities.

MyUW

Overall, faculty rated their computer expertise highly. When asked to what extent they would like to use the Web if they could easily obtain support and service, they rated their interest consistently high across a variety of tasks and activities. Though faculty did express strong interests in integrating technology into their courses, lack of time was the biggest concern and barrier described for actually integrating technology into their curricula.

What may assist faculty to overcome this barrier are centralized mechanisms for creating Web-based content that reduce the time burden by linking academic, administrative, and pedagogic resources. The MyUW portal has emerged as the enterprise-wide solution for meeting this need. Research and development of MyUW must continue to assure that back-end components work together

seamlessly to provide instant, dynamic access to the administrative infrastructure, while providing an easy-to-use interface to relevant content for all UW instructors. The continued development of MyUW will help satisfy student desires for educational technology by streamlining UW instructors' production of quality Web-based academic materials for their students.

PowerPoint

The UW community defined PowerPoint as a key educational technology on the University of Washington's campus, identifying this tool as helpful in visually demonstrating course concepts. However, using PowerPoint for this purpose is perceived differently among students and faculty.

Students explained that the greatest benefit of using PowerPoint in the classroom is the technology's ability to visually demonstrate concepts. They articulated their desire to have PowerPoint integrated into their courses for this purpose; however, students also reported that faculty are not always proficient in using the technology for this objective.

One third of faculty survey respondents reported they have never used PowerPoint. In our qualitative data it was also revealed that often faculty do not use PowerPoint because they feel locked into a "demonstration model." This defines a divide between faculty and students perceptions of the benefits that result from integrating PowerPoint into the classroom.

In result, the University may wish to consider providing faculty training addressing appropriate and inappropriate uses of PowerPoint. This training may include how to use the software effectively to create visual demonstrations and how to effectively integrate this technology into the classroom. This recommendation could be met by enhancing Catalyst's basic skills workshops to focus on using PowerPoint effectively in the classroom. By educating faculty about PowerPoint, they can make informed decisions

about whether this technology can enhance their courses and how to match the technology with their lecture style. The data also provides an opportunity for the University to inform faculty to avoid using PowerPoint if they are not proficient with it.

Students reported that presently faculty are using PowerPoint regardless of their proficiency with the technology and that when PowerPoint is used ineffectively they disengage from the lecture. Some even described the technology as detracting from their learning. Faculty training may be a strategy to assist faculty and students with the struggles surrounding effective PowerPoint use.

Discussion Boards

Though few faculty and students have used discussion boards at the UW, the community expressed a powerful desire to integrate this technology widely. Both the survey and qualitative research indicated that discussion boards are a rising technology at the UW. Faculty expressed their desire to use this technology due to its ability to extend the classroom with asynchronous discussion, afford peer teaching, and increase communication with a more representative sample of students in their courses.

Students also expressed a strong desire to use this technology in their courses. A prominent theme among the qualitative data was that students have such a high appreciation for the peer-to-peer collaboration this technology affords that they would like the University to require its use in large lecture courses.

Considering that this technology draws such interest from the community, the University may want to support the adoption of the tool by assisting faculty and students to use it most effectively.

Specific strategies the University may want to implement include: training faculty how to teach students to make most of online communication, continuing the development of

online guides for using discussion boards effectively, and supporting research on the tool that aims to define how this technology can be integrated effectively with instructional objectives.

Email

Faculty and students use email daily. Though the community defined this technology to be useful for one-on-one interactions, both faculty and students agreed that email listserv's are extraordinarily helpful and effective for communicating with all students enrolled in a specific course. Many faculty reported already using this feature of email. However, there was a portion of faculty that desire to use listserv's but described a need for greater support on how to create them. The University may want to respond to this need by more widely advertising where faculty can go for help to create listserv's and continuing to provide support for the development of Web-based listserv software such as MailMan.

UW Electronic Reserves

UW Electronic Reserves are a valued and desired resource by both faculty and students. The University has an opportunity to continue to support the use of this technology through several strategies.

First, this report illuminated a discrepancy between faculty and student perceptions of using electronic reserves. Faculty described a concern that their students are unable to effectively and easily use this resource; therefore, they are deterred from posting course materials as electronic reserves. Students, however, reported a high proficiency with this technology and stated information within electronic reserves is easily accessible. The University has an opportunity to respond to this finding by educating faculty that students are comfortable using electronic reserves and encouraging them to utilize this resource.

Secondly, faculty described a barrier to using this technology as the long wait to post their materials on E-reserve. Faculty recognize the conveniences that this resource affords, but reported that they do not always post their materials due to the sometimes extended wait before electronic reserves are actually available online. The University can respond to these faculty barriers by expediting the process to place course materials online within E-reserves. The UW Libraries may wish to consider applying more resources in this area.

Student and Faculty Research on the Web

The Web has emerged as a powerful resource among the University community. Faculty and students depend on the Web for their coursework and research; however, the motivations and competencies surrounding effective and efficient uses of this resource vary dramatically across faculty and students.

Faculty use this technology as a tool to engage in research that complements more traditional forms of inquiry. In contrast, students depend much less on traditional methods of data collection, such as visiting the library to access print journals, and instead are relying heavily on online journals and other Web-based resources. Furthermore, students look to the Web to create connections between course content, larger societal concepts, and career opportunities. Students utilize the Web for multiple objectives, where faculty use Web research primarily as an adjunct to their current research practices.

This identified discrepancy defines an opportunity for the University to place support in developing students' skills to effectively utilize the Web for research purposes. Faculty explicitly described students as having underdeveloped information literacy skills and overdeveloped Web searching skills. The University may wish to strategize how to assist

faculty members to integrate information literacy principles into their existing curricula, both at the individual and departmental level.

The University may want to consider taking advantage of the opportunity to integrate information literacy skills, including ethics and research methods, into the General Education Requirements. Faculty explicitly stated that students often plagiarize what they find on the Web. However, faculty described this occurrence as a direct result of students not being educated what the standards are surrounding plagiarism; students need greater exposure to proper research methods. This finding defines a prospect for the University to respond to students' need to learn how to engage in the appropriate referencing protocol to avoid the offense of plagiarism. Librarians and faculty who teach information literacy at the UW may serve as a strong resource to consult.

Video Clips

Video is a form of media that plays a significant role in our society. Surprisingly, students perceive this tool as not only one of entertainment, but an interesting and engaging manner to comprehend course content. Students reported appreciating the presentation aspect of video clips and its ability to connect “real-world” concepts with abstract lecture content.

Our research indicates that faculty agreed with students, and desired to use this technology in their courses. A third of faculty reported already using this tool frequently, and another third of faculty expressed that they *very much* desire to use this technology in their courses. However, they defined a barrier to actually integrating this tool: a lack of support and services. The University has an opportunity to respond to this finding by integrating more of the appropriate equipment within the classroom environment to support the use of video. Novice digital video editing workshops may also benefit the University community at large.

Student-Specific Educational Technologies

The knowledge architecture of the future cannot be complete without including those technologies identified in this report as student-specific educational technologies. Students reported frequently using and valuing some technologies that were not addressed by faculty. In result, the University has an opportunity to raise faculty awareness of these student-specific educational technologies, and to support future studies investigating students' uses of these tools for their coursework and research.

Instant Messaging

Instant messaging is a tool used daily for coursework by a large portion of the University's student population. This report defined IM as a tool used by students to facilitate a new social context for student learning to take place. The University has an opportunity to respond to this finding by conducting research around students' use of this technology.

Considering this technology supports instantaneous communication between students, there is potential for students to plagiarize one another's work for assignments. This technology can also positively impact the social learning environment at the UW. To assure that this tool is being used most effectively and honestly by students, the University needs to conduct extensive research investigating student uses of this technology. Such studies could explore how this technology can be effectively integrated into the daily lives of students to enhance their learning experience, rather than detract from it.

Excel

Our data indicates that there is a discrepancy between faculty and student perceptions of Excel. Differences occur in the community's view of Excel's academic, learning value and the importance for students to be proficient with this technology by graduation. Most students are not using Excel, and evaluate their skills in using the technology to be novice. Yet by graduation two-thirds of students would like to be advanced or expert in using this technology. Faculty disagreed dramatically, only a small fraction of the survey respondents evaluated using spreadsheets or Excel as a necessary skill for students to acquire by graduation.

The University now has an opportunity to respond to this finding by raising faculty awareness of student desires for this technology to be integrated into their academic experience, provide opportunities for faculty to learn how to use this technology, and develop methods for students to acquire skills to effectively use this technology by graduation.

Undergraduate Research Opportunities

This report reflects positively on the University of Washington as a research institution. A dynamic finding among the data is that students also regard research in endearing ways. Students described a desire to get involved in undergraduate research, and defined a need for the university to more widely disseminate research opportunities. Methods by which this could be achieved include: placing undergraduate research opportunities on MyUW and the UW Home page, advertising them more often in the Daily, and prompting faculty to describe opportunities on their course Web sites.

Enhancing the Culture of Educational Technology

Technology adoption can thrive only in a culture that supports it. The knowledge architecture of the future cannot be built in an environment that does not sustain its construction, the weather must cooperate. Yet in our research, faculty described the culture and support surrounding educational technology across the University to vary widely.

There were multiple contributing aspects to this variation. First, teaching was frequently described as an isolated experience, inhibiting dialogue between faculty members regarding their integration of technology into their curriculum. Secondly, faculty described a culture where students are pushing for educational technology. This drives many faculty members to integrate technology into their courses based on expectations of their students, rather than their own desires to enhance their curricula or personal beliefs that technology enhances student learning. Finally, faculty described the University’s culture to perceive online resources and journals as less reputable than those in print form.

In response to this culture, we recommend implementing new modes of communication between departmental colleagues to create a culture where technology is openly discussed to assist in alleviating barriers. By providing an opportunity for faculty to share their frustrations, successes, and observed student learning benefits, the culture surrounding technology on the UW campus may be enhanced.

Enhancing the Culture

Minimal	Intermediate	Complex
Perceived skill levels	Departmental Web sites Personal profiles Informal events	Incentives

Table D3: Recommendations on enhancing the culture of educational technology

Perceived skill levels are a barrier reported by faculty to adopting technology. Faculty are among a culture where they perceive technology to be difficult to learn, so difficult that they do not possess the skills to integrate it into their courses. However, survey data indicated that faculty do in fact have the skills to learn and use their desired technologies. They may be simply unaware they have the abilities to do so. The University has an opportunity to respond to these findings by educating faculty in forums and published campus materials that they do have the skills to develop and integrate technology into their courses.

Departmental Web sites are an effective medium to increase faculty communication. We advocate providing links on these sites to concrete examples demonstrating how individuals in a department are utilizing technology. These links may raise awareness of technology use within the community.

Personal Profiles on Web sites provide faculty an opportunity to communicate and share their experiences with technology. Therefore, UW technology groups may wish to provide instructors with more opportunities to create profiles, including being profiled on the Catalyst Web site, and the UW home page.

Informal Events that bring knowledge builders together to reflect on educational technologies is one method to increase faculty communication and awareness of technology. This strategy could be implemented through a monthly informal discussion such as “WebEd,” a PETTT-hosted event where faculty and researchers come together to share information surrounding educational technologies. These discussions have proved extraordinarily successful, as the excitement, research, and experiences regarding technology on campus are disseminated across the UW community.

Incentives increase the appreciation of innovative teaching practices using technology. We propose recognizing faculty that have emerged as leaders of technology integration during the tenure review process, serving as a formal

method to inspire faculty to adopt technology into their teaching. The development of a faculty award for excellence in teaching with technology may also be effective in recognizing faculty who have successfully created and executed innovative teaching with technology.

Contrasting faculty descriptions of their culture surrounding educational technology, students reported embracing educational technology as a key component in their culture. Students utilize many tools daily, perceiving these technologies to not only enhance their academic experiences, but their social experiences through communication technologies such as instant messaging, email, and discussion boards. Students are among a culture where it is acceptable to desire to learn technology. Students of all proficiency levels choose to be instructed how to effectively use technology and reported a need to be advanced or expert by graduation in over half of all technical skills and technologies investigated.

This cultural phenomenon between faculty and students may provide insight as to the difference between faculty and students self-rated proficiency with technology for their coursework and research. Where students are among a community where technology is widely accepted and desirable, faculty are part of a community in which they believe technology is not perceived as a consistent, reputable learning tool. This may have resulted in students inflating their proficiency scores, such as their information literacy skills; it is the cultural and social norm. However, faculty may have underrated their abilities in result of being a member of a perceived community that does not widely accept technology.

Opportunities for Future Research

The scope of this research was massive and our data analysis was as thorough as possible; nonetheless, opportunities certainly exist for future research. At the University of Washington, this research may include follow-up studies to this one that employ the same methodology every two years, aiming to keep pace with changes in technology. New areas may also be explored in separate future studies targeted to explain unresolved issues in this data set. Lastly, we believe this study design achieves a level of robustness that will allow other post-secondary institutions to replicate it, thereby fostering a diffusion of understanding, supported by evidence, of technology opportunities and needs in higher education.

Refinements and Follow-up Studies

PETTT anticipates being involved in a second iteration of this study in 2004 that integrates knowledge gained in the present study, in collaboration with our partners, into the future study design. One of two major limitations of this study can be revealed in the inconsistencies between survey instruments. Improvements in the wording of our questionnaires over time resulted in significant enough differences to invalidate some cross-correlations between faculty and student survey data. In the future, the items within these instruments will be worded to provide a more exact match in the data sets and assure an ability to perform cross-correlations among the surveys.

The other major problem we found emerging from our study was a difficulty in grouping technology skills with self-rated expertise. We applied several factor analysis matrices to data from the frequency of technology use and self-rated proficiency items in both surveys. Unfortunately, these analyses did not resolve. Our solution was to define and validate a self-rated Technology Proficiency Score. While the TPS is a valid, useful measure for understanding perceptions of proficiency in our target populations, resolved factor analyses around usage will help us gain a richer understanding of how technology

skills in post-secondary education may be grouped. We intend to refine the language in our 2004 survey instruments to achieve this goal.

Unresolved Issues

Questions emerged from this data that may need to be answered in future studies. We have learned that heightened interests exist at the University of Washington in broadband wireless networking, multimedia development, and video archives of instructional materials. Our study did not investigate these areas, although some thought-provoking findings surfaced. Clearly these are areas for future research, in terms of perceptions, expectations, and use.

We also found that the connection between technologies used in post-secondary education and in career fields needs to be more fully explored. For example, the University community may benefit from descriptive studies investigating what technologies faculty use in professional meetings and what technologies practicing professionals use in their various disciplines.

Lastly, PETTT believes that additional research is needed in the area of distance education. This study did not sufficiently address the similar and unique technology needs of distance education students. We must rely on distance education experts, teachers, and students to define those questions that will best elucidate this area on its own and in combination with face-to-face, classroom, or more traditional forms of higher education.

Future Contributions to Higher Education

PETTT will continue to extend efforts in pursuing an evolved, research-informed understanding of educational technology at the post-secondary level. Advances in technology development and adoption within our institution are certain; PETTT plans on

conducting research at every stage of this educational revolution for the UW to make the most of these rapid changes.

PETTT also will provide technical assistance to others searching for their own answers. We aim to prove or disprove anecdotes with evidence and assist our community in its growing knowledge of how we can best use technology in the service of education. This growth will be fostered through a more comprehensive understanding of our community's needs and challenges, and through acts and strategies to improve academia that successfully integrate educational technology.

CONCLUSION

This report encourages one to consider the vision of the future: a future where technology becomes a well-integrated, imperative tool in the higher education environment. The results provide the University of Washington a unique opportunity to hear the needs and perceptions of the community regarding educational technology.

As our society continues to rapidly grow in the use and adoption of technology, the University of Washington is challenged: how does an institution create an environment that is responsive and adaptive to the technical needs and desires of the individuals who comprise it? By constructing the knowledge architecture of the future, as drafted in this report, this question may begin to be answered through the successful development and implementation of research-informed activities and discussions.

The University of Washington now must embrace the dynamic potential that educational technology can bring, as defined by its faculty and students. It should not be overlooked that technology is an enhancement of instruction, a tool to make new connections and advance knowledge through electronic means. It is not a substitute for the human touch and interaction necessary for superior education, but rather a new mechanism to present

information and enhance communication in meaningful ways. It is through continued research, iterative development cycles of tools, listening and responding to the desires of students and faculty, and continued problem-solving to allocate resources most effectively, that technology can have a powerful impact on the University of Washington's learning and teaching environment.

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APPENDICES

Appendix A. Methods

I. Defining our Methods

The methods employed in this multidisciplinary study aimed to transcend the qualitative and quantitative debate by coupling various research strategies. For this study, we developed four intricately related components.

Faculty Survey: The Faculty Survey on Instructional Technology 2001 was sponsored by the Provost's Office, the Faculty Senate and the Faculty Council on Educational Technology, and was carried out by the Office of Educational Assessment (OEA) in collaboration with the Program for Educational Transformation through Technology (PETTT). The survey instrument primarily consisted of closed-format questions such as multiple choice; however, some open-ended questions were included, as well.

Student Survey: The Student Survey on Educational Technology 2002, a companion to the faculty survey, was also supported by PETTT and disseminated by OEA. The strength of this survey was the result of a dynamic collaboration of various groups on campus including, the Office of Educational Partnerships, the Student Access and Computing Group, the Student Technology Fee Committee, Computing and Communications, OEA, PETTT, and the UW Libraries. The survey instrument primarily consisted of closed-format questions, paralleling those of the faculty survey, with several open-ended questions at the conclusion of the survey.

Faculty Focus Groups: Within the faculty survey, respondents indicated if they had an interest in participating in focus groups exploring the topic of educational technology further. These individuals were then recruited to participate in focus groups conducted by members of PETTT's research team. The goals of these discussions were to gain in-depth contextual detail of faculty's experiences and uses of educational technology at the University and to investigate the findings of the faculty survey in greater detail. We asked similar questions in faculty focus groups and student focus groups.

Student Focus Groups: Little research has relied on students themselves to define their perceptions of educational technology within the context of the university community. In response, we allowed the ultimate consumers of our educational efforts drive this study by adopting a value-sensitive design. We enrolled three students from various disciplines in a two-quarter undergraduate research course. Objectives for this course included: learning the basics of research design, developing content for student focus groups, conducting these discussions and performing content analyses of the data collected. Therefore, students created, led, and analyzed student focus group data.

The Interplay of Methods:

Each of the four data collection methods informed the design and development of the other approaches. The relationships between various methods helped to articulate a vision of the future role of technology at the UW that is both holistic and systemic. See Figure 1 to identify these various pathways of data collection and methods development.

Faculty Survey:

This project initially began with the design, dissemination, and analysis of the faculty survey. Interesting findings illuminated within the survey were then investigated in greater depth in the faculty focus groups. Data within the faculty survey pertaining to student uses of educational technologies were investigated in the student focus groups. The designed relationship of these three methods afforded a richer interpretation of the faculty survey data.

Student Survey:

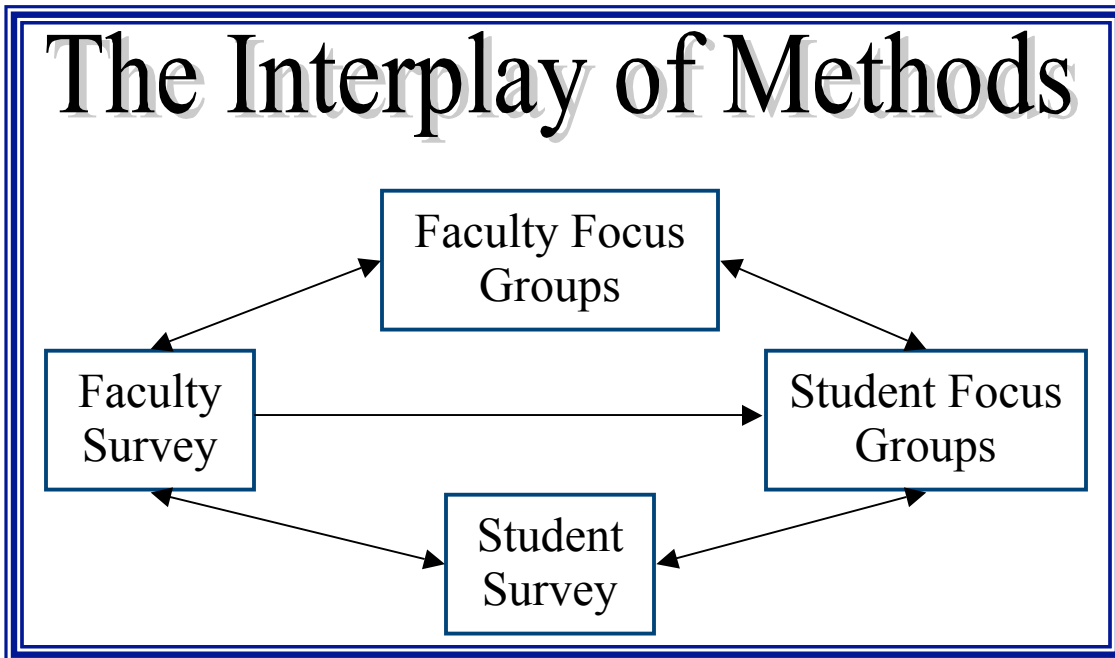
The student survey was informed by student focus groups. Undergraduate students themselves developed the questions asked in the focus groups, obtaining data that defined student concerns and uses of educational technology. This data was investigated further by directly influencing the design and content of questions within the student survey.

The faculty survey also influenced the design of the student survey instrument. Several questions were identical to the faculty survey, although some variations existed between the two instruments. These parallel questions allowed for an in-depth comparison of student and faculty uses and perceptions of educational technologies.

Focus Groups:

The content of the faculty focus groups was modeled after the student focus groups. Therefore, PETTT researchers were able to compare student uses and perceptions of technology with faculty's.

Figure 1.



II. Procedures for Data Collection

Faculty Survey: The sampled population included all individuals (faculty, librarians, and teaching assistants) that were listed as an instructor on record for at least one class during winter, spring, or autumn quarter in 2000 (Lowell & McGhee, 2001). The total number surveyed was 5,789, and 1,879 instructors returned the questionnaire, a 35.8% response rate (Lowell & McGhee, 2001). Please refer to the Office of Educational Assessment report of faculty survey findings to obtain a copy of the survey instrument and detailed descriptions of the data collection, participation rates, and recruitment procedures. <http://www.washington.edu/oea/0106.htm>.

Student Survey: The sample population was defined as all students 18 years of age or older who were enrolled as of the 10th day of autumn quarter 2002 at the Seattle, Bothell, or Tacoma campus (McGhee, 2002). Additionally, a student must not have been selected for any other concurrently-running OEA survey (McGhee, 2002). From that population, 3000 students were randomly selected. A total of 961 students (32%) completed the questionnaire (McGhee, 2002). Please refer to OEA's report of student survey findings to obtain a copy of survey instrument and detailed descriptions of the data collection, participation rates, and recruitment procedures. <http://www.washington.edu/oea/0304.htm>

Student and Faculty Focus Groups: Approximately 100 faculty and students participated in the focus groups for this study. Recruitment for student focus groups took place in two stages, each employing an email solicitation for participants. These email messages were sent to the entire undergraduate student population. An additional effort was made to recruit Freshman Interest Group students by email. Recruitment for faculty

focus groups also took place in two stages, each employing an email solicitation for participants. These email messages were sent to a random selection of faculty survey respondents who indicated they would be willing to participate in focus groups on educational technology. Focus group participation was voluntary and uncompensated.

III. Data Analysis

The data analysis of the student and faculty surveys consisted of our interpretations of previously tabulated data reported by the Office of Educational Assessment. For thorough descriptions of the procedures and methods applied to the statistical analysis please refer to OEA's reports of findings.

The process of analysis emerged from articulated research questions that investigated educational technologies from a holistic perspective: aiming to define the uses, perceptions, and expectations of educational technologies across the UW community. See below for detailed descriptions of research question development.

Faculty Survey: Development of research questions around the faculty survey data was a collaborative effort of discussion and consultation among various stakeholders on campus, including the Center for Instructional Development and Research, the Educational Technology Development Group, and the Office of Undergraduate Education. For a complete list of collaborators, please visit the PETTT Web site. PETTT's research questions explored:

- how do different faculty perceive and experience educational technology at the UW
- how do faculty prefer to learn about technology
- what are faculty perceived barriers to adopting technology
- what supports and incentives might the university provide for helping faculty's use and integration of technology into their courses

Student Survey: In collaboration with the Office of Educational Partnerships, the Student Access and Computing Group, the Office of Educational Assessment, UW Libraries, Computing & Communications, the Student Technology Fee Committee, and PETTT research staff, research questions were developed to be answered by student survey data. PETTT's research questions placed a focus on interpreting cross-tabulations that would investigate the following:

- how expertise levels impact technology use
- how expertise levels change over time spent on the UW campus
- how students' preferred methods of instruction change with their self-rated expertise
- how a student's major and class standing impacts the importance of technology use and expertise level
- what students, if any, desire a technology course
- how we can gauge students' proficiency with technology
- what are the changes students expect in their technology proficiency from their current abilities to their abilities at graduation

Faculty vs. Student Survey: PETTT also established a set of research questions to consider when comparing data tabulated across the faculty and student surveys. These questions were derived for the purpose of comparing and contrasting student and faculty uses and perceptions of educational technology across the UW campus. Specifically, we aimed to compare the following:

- faculty and student self-rated expertise levels with technology and how they differ across departments and majors
- the preferred methods for learning about technology
- what technologies are being used more by one population than another
- if faculty desires to integrate technology complement student beliefs of what tools are important to provide
- the intersections and discrepancies between student desires to use technology versus actual faculty integration of these tools into their courses

Student and Faculty Focus Groups: Members of the PETTT research team and undergraduate students enrolled in the associated research course performed uniform content analysis of the faculty and student focus groups, respectively. We identified emergent themes and patterns in the focus group data to provide a systematic and objective means to make valid inferences from the data. The identification of these themes was the result of researchers concurrently performing the continuum of analysis. First researchers familiarized themselves with the raw data. They then created descriptions of the data through summarizing statements of participant comments and developing themes, followed by verbatim quotes illustrating each theme. Finally, researchers interpreted these themes to provide meaning to the data. This qualitative research is intended to describe the emergent themes discovered in the research that are supported by sufficient data to constitute a trail of evidence.

IV. Summary of Methods

One limitation of this research design is that the focus group participants were self-selected and although the dissemination of the survey was randomized, respondents were also self-selected. We believe the pool of respondents is demographically representative of the University; however, the data elicited in this research project may not have been a representative sample of attitudes of the entire undergraduate and faculty population at the University of Washington.

However, by pairing qualitative and quantitative methods to inform the design and development of the research, this study overcame the challenge of understanding educational technology from a systemic perspective. This project's methods established what might be called a learner-centered, faculty-centered, community-centered assessment, resulting in a complete picture of educational technology in terms of faculty and student learning issues. It should be noted that the methods employed in PETTT's arm of the project did not focus on the infrastructure of technical support, nor a departmental analysis, but rather the creation of a multidisciplinary, community wide story of technology on the University of Washington campus.

Appendix B. Statistical Tables

Table 1. Mean comparisons of the importance of online resources in order of significance. (from Student Survey number 10 and Faculty Survey number 18)

Item (using Student Survey #10 wording except as indicated)	Faculty (n=1058)	Student (n=412)	F(1,1468)
Course materials (conservative): Faculty 18A vs Student 18ABM Mean (Course syllabi, Course outlines or lecture notes, and Grading criteria)	1.9	2.3	48.1**
Simulations or visualizations	1.0	1.5	84.4**
Presentations of compositions, dances, or other musical/art activities	.2	1.0	481.6**
Links to course reserves	1.5	2.0	70.5**
Quizzes or surveys	1.0	1.6	151.7**
Course grades	1.0	2.1	364.0**
Class discussions	1.2	1.4	9.8*
Links to other archived materials	1.6	1.8	10.6*
Posting of student work	1.1	1.2	2.9
Course materials (liberal): Faculty 18A vs Student 18ABCDM Mean (Course syllabi, Course outlines or lecture notes, Grading criteria, Video archives of lectures, and Problem sets or exercises)	1.9	2.0	5.8
Links to research opportunities (vs. Faculty 18J)	1.7	1.8	4.8

Note. Scale: 0 = Not important/Not at all, 1 = Somewhat important/Somewhat, 2 = Very important/Very much, 3 = Extremely important/Already use

* $p < .004$

** $p < .001$

Table 2. Percent of student survey respondents who have NEVER used listed technology.

Technology	Percent
Database Software (e.g., Access, FileMaker)	54
Web (HTML) editors (e.g., GoLive)	55
Web-based homework submission (e.g., Catalyst E-submit)	59
Web-based surveys/quizzes (e.g., Catalyst WebQ)	60
Web-based discussion boards (e.g., Catalyst Epost)	64
Slides, filmstrips and/or projected movies	65
Bibliographic citation management software	67
Statistical analysis software (e.g., SPSS, SAS)	68
Web-based collaboration tools (e.g., Catalyst Peer Review)	71
Mathematics Software (e.g., Mathematica)	73
Software development tools (e.g., Visual Studio, compilers)	73
Web-based feedback forms (e.g., Catalyst Umail)	73
Computer-generated animation/graphics/CAD software (e.g., Bryce)	76
Multimedia authoring software (e.g., Premier, Final Cut Pro)	76
Simulation software (e.g., medical tools)	77
Geographic information software (e.g., ArcView/ArcInfo)	84
Video conferencing	84

Note. Numbers indicate percent of student survey respondents who selected never having used each of the listed technologies.

Table 3. Percent of faculty survey respondents who have NEVER used listed technology.

Technology	Percent
Graphics (e.g., Photoshop)	50
Slides, filmstrips and/or movies	50
Calendar/scheduling	53
Computer-projected presentations	54
Publishing (e.g., Acrobat, PageMaker)	55
Web (HTML) editors (e.g., Frontpage)	56
Statistical analysis software	60
Software to record/manage grades	61
Database (e.g., ACCESS, FileMaker)	68
Catalyst webWeb-based tools	81
Digital video and/or audio	81
Modeling or simulations	83
Computer-generated animation/graphics	84
Video conferencing	89
Multimedia authoring software	89
3-D modeling	91
Courseware (e.g., WebCT, Blackboard)	93
Video editing software	93

Note. Numbers indicate percent of faculty survey respondents who selected never having used each of the listed technologies.

Table 4. Preferred Learning Methods by Survey Group

	Students 2002	Faculty 2001
Workshops	32.3%	46.5%
Online computer tutorials	31.7	23.5
Books, journals, tutorials	24.5	38.6
Exploring, experimenting	45.8	67.1
Help from colleagues, friends, family	46.4	73.4
Telephone consultants	10.5	19.2
Computer lab staff	28.0	51.0
Don't wish to learn more	1.7	4.0

Note. Numbers indicate percent of group who selected each learning method.

Table 5. Correlations between Self-rated Expertise and Learning Preferences.

	Zero-order	Controlling for group membership
Workshops	-.14**	-.14**
Online computer tutorials	.04*	.04*
Books, journals, tutorials	.18**	.18**
Exploring, experimenting	.17**	.18**
Help from colleagues, friends, family	-.11**	-.11**
Telephone consultants	-.05*	-.05*
Computer lab staff	-.07*	-.06*
Don't wish to learn more	-.02	-.01

Note. $N = 2618$. Positive correlations indicate that higher expertise ratings are associated with greater likelihood of selecting a particular learning method, while negative correlations indicate that higher expertise is associated with decreased likelihood of selecting a particular method.

* $p < .05$

** $p < .001$

Table 6. Student mean self rated technical expertise by subcollege.

Subcollege	M
Engineering (n=101)	2.97
Architecture (n=25)	2.60
Education (n=29)	2.55
Fisheries (n=11)	2.55
Business (n=86)	2.48
A&S Natural Sciences (n=116)	2.46
Medical (n=28)	2.46
ISchool (n=11)	2.45
Forestry (n=14)	2.43
A&S Social Sciences (n=132)	2.42
A&S Humanities (n=37)	2.38
Law (n=14)	2.36
Tacoma Campus (n=30)	2.33
Nursing (n=21)	2.19
Public Health (n=21)	2.19
A&S Arts (n=41)	2.17
Social Work (n=11)	2.00

Note. Scale: 1 = Novice, 2 = Intermediate, 3 = Advanced, 4 = Expert. M = mean self-rated student expertise. n = number of respondents per subcollege.

Table 7. Student class rank by current TPS and desired TPS by graduation.

Student Class Rank	Current TPS	Desired TPS
Freshmen	2.04	3.12
Sophomores	2.2	3.16
Juniors	2.07	2.89
Seniors	2.2	2.83
Masters	2.2	2.94
Doctoral Level	2.4	2.4

Note. Scale: 1 = Novice, 2 = Intermediate, 3 = Advanced, 4 = Expert. Numbers represent mean self-rated TPS. $F(5,512) = 1.27, p = .015$

Table 8. Student self rated desire for technical expertise **by graduation** as a percentage of those surveyed.

Technical Skill Goal	0	1	2	3	4
Set up a personal computer (n=551)	4	6	28	38	24
Connect a computer to a network (n=548)	8	10	30	33	20
Make informed decisions about purchasing hardware/software (n=545)	1	7	30	39	23
Create a Web site (n=550)	8	15	31	30	17
Use basic operating system features (n=884)	.6	2	18	44	35
Use a word-processor to create documents with text and illustrations (n=892)	.3	.2	11	44	44
Use a graphics or art package to create illustrations, slides, or images (n=551)	1	7	25	37	30
Use a computer to find scholarly information and resources (n=890)	.1	.2	9	40	51
Critically evaluate information from the Internet and other sources (n=890)	.2	.9	12	44	43
Use a computer to communicate with others (n=551)	0	.5	10	43	47
Use a spreadsheet for computations and to create charts and graphs (n=891)	.9	3	20	42	34
Use a database system to set up and access information (n=549)	4	8	28	36	24
Effectively present information drawn from multiple sources (n=886)	.6	1	15	42	41
Use instructional materials to learn how to use new applications or features (n=548)	2	4	27	41	28

Note. Scale: 0 = Never tried/Not interested, 1 = Novice, 2 = Intermediate, 3 = Advanced, 4 = Expert. Numbers indicate percent of group who selected level of expertise. n = number of respondents per item.

Table 9. Comparison: Student *current* self-rated mean for technical skill (M1) vs. self-rated mean of desired expertise *by graduation* (M2).

Technical Skill	M1	M2
Set up a personal computer	2.2	2.7
Connect a computer to a network	1.7	2.5
Make informed decisions about purchasing hardware/software	2.0	2.8
Create a Web site	1.1	2.3
Use basic operating system features	2.6	3.1
Use a word-processor to create documents with text and illustrations	2.8	3.3
Use a graphics or art package to create illustrations, slides, or images	2.0	2.9
Use a computer to find scholarly information and resources	2.8	3.4
Critically evaluate information from the Internet and other sources	2.6	3.3
Use a computer to communicate with others	3.1	3.4
Use a spreadsheet for computations and to create charts and graphs	2.2	3.1
Use a database system to set up and access information	1.6	2.7
Effectively present information drawn from multiple sources	2.4	3.2
Use instructional materials to learn how to use new applications or features	2.2	2.9

Note. Scale: 0 = Never tried/Not interested, 1 = Novice, 2 = Intermediate, 3 = Advanced, 4 = Expert. **M1** = Students' **current** self-rated expertise with technical skill **M2** = Student desired self-rated expertise **by graduation** of technical skill.

Table 10. Student agreement: The UW should require all incoming students to take a course designed to build basic technology skills.

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
15	20	22	28	15

Note. Numbers indicate percent of group who selected level of agreement n = 554.

Table 11. ANOVA Results for Group by Expertise Comparisons.

Item (using Student Survey #13 wording except as indicated)	Group	Df1,df2	Expertise	df1,df2	Group x Expertise	df1,df2
Web (HTML) editors (e.g., GoLive)	4.1	1,1911	33.1**	3,1911	7.7**	3,1911
Calendars/scheduling software (e.g., MyUW, Yahoo)	11.2*	1,1911	10.2**	3,1911	10.2**	3,1911
Publishing software (e.g., Acrobat, InDesign)	16.2**	1,1911	17.5**	3,1911	11.6	3,1911
Mean of Faculty 15 L&N vs. Student 13H (Authoring/Editing)	24.8**	1,1911	22.5**	3,1911	1.1	3,1911
Internet/Web browsers (e.g., Netscape/Mozilla, IE)	15.8**	1,1911	34.4**	3,1911	2.6	3,1911
FACULTY 15H Catalyst vs Mean of Student 13 ab-af	36.6**	1,1911	8.7**	3,1911	<1	3,1911
Spreadsheets (e.g., Excel)	11.0*	1,1911	50.7**	3,1911	3.2	3,1911
Word processors (e.g., Word, Word Perfect)	7.9	1,1911	9.1**	3,1911	1.8	3,1911
Presentation software (e.g., PowerPoint)	7.9	1,1911	38.4**	3,1911	2.1	3,1911
Database software (e.g., Access, FileMaker)	<1	1,1911	29.3**	3,1911	1.1	3,1911
Graphics software (e.g., Photoshop)	<1	1,1911	33.0**	3,1911	4.5	3,1911
Mean of Faculty Q/Y vs. Mean of Student I/K (simulations/CG)	1.0	1,1911	49.3**	3,1911	3.2	3,1911
Statistical analysis software (e.g., SPSS, SAS)	3.1	1,1911	19.3**	3,1911	2.8	3,1911
Video conferencing	7.2	1,1911	8.3**	3,1911	<1	3,1911
Email (e.g., Pine, Outlook, Eudora)	3.2	1,1911	5.7*	3,1911	2.2	3,1911
Slides, filmstrips and/or projected movies	7.7	1,1911	<1	3,1911	3.5	3,1911

* $p < .003$ ** $p < .001$

Table 12. Faculty self-rated expertise versus frequency of technology use.

NOVICE	INTERMEDIATE	ADVANCED	EXPERT
Word Processors M=3.6	Novice +	Novice + Intermediate +	Novice + Intermediate + Advanced +
Internet/Web Browsers M=2.9	Spreadsheets M=2.1	Calendars/Scheduling Software M = 2.5	Graphics Software M=2.5
Email M=4.2		Presentation Software M = 2.4	Web Editors M = 2.6*

Note. Scale: 0 = Never, .5 = Once a year, 1.5 = Several times a year, 2 = Once a month, 3 = Several times a month, 4 = 1-2 times a week, 5 = Every day. M = mean frequency of use reported for listed technology. Technologies were only listed in table when mean indicated that half of the faculty respondents reported using the technology once a month or more (M= ≥ 2.0).

*Students from all expertise levels are using Web Editors less than once a month

Table 13. Student self-rated expertise versus frequency of technology use.

NOVICE	INTERMEDIATE	ADVANCED	EXPERT
Word Processors M=3.6	Novice +	Novice + Intermediate +	Novice + Intermediate + Advanced
Internet/Web Browsers M=3.77	Spreadsheets M=2.05		Graphics Software M=2.07
Email M=4.59			Presentation Software M=2.05
Calendars/Scheduling Software M=2.13			

Note. Scale: 0 = Never, 1 = Less than once a month, 2 = Once a month, 3 = Several times a month, 4 = 1-2 times a week, 5 = Every day. M = frequency of use reported for listed technology. Technologies were only listed in table when mean indicated that half of the student survey respondents reported using the technology once a month or more (M= ≥ 2.0).