

Evolution of Technology in Teaching @ Harvard University

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Running and Growing the Small Company

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RESEARCH QUESTION AND MOTIVE

As technology changes consumer lifestyles and business practices, it is also impacting the way we learn. “An instructor’s knowledge of subject matter and analytical prowess are no longer enough; they must be coupled with social and communications skills if active learning is to be effective.”¹ Used appropriately, the Internet and digital technologies are effective communication tools to facilitate greater understanding of a situation or an incident. As a result, many universities have been integrating new interactive media into course curricula to enhance conventional classroom-based learning.²

The purpose of our paper is to examine the use of technology in teaching at Harvard University based on a selected sample of Harvard Schools: Harvard Law School, the Graduate School of Design, Harvard Business School, and the Graduate School of Arts and Science. In this paper, the word technology is used to encapsulate hardware, such as audio-video equipment, presentation equipment, and logistical layout in the classroom, and software, such as course platforms, polls, discussion boards, chat rooms, etc. as well as the use of the Internet, within or in conjunction with the classroom (as long as they are course-specific).

We are interested in determining whether the use of technology enhances knowledge and learning. Furthermore, we want to investigate the evolving use of technology, the drivers of technological change, and the influence of stakeholders in the decision making process of adopting new technology. Lastly, we are interested in exploring the reasons for the variance in the use of technology across schools at Harvard.

RESEARCH METHODS

We conducted extensive primary research to explore answers to our questions. Our initial list of target interviewees consisted of faculty and IT personnel at the various aforementioned schools. For these initial sets of interviews, our goals were to gain some preliminary background on the process of technology application, and to locate additional stakeholders who could further improve our understanding of these processes. As a result, our list of interviewees extended to faculty assistants, audio-visual technicians, students, and researchers. In addition to interviews, we attended classes to observe the physical environment and the actual use of technology in the classroom from setting-up to

1 David Garvin and Roland C. Christensen, *Education for Judgment: the Artistry of Discussion Leadership*, ed. C. Roland Christensen, David A. Garvin, Ann Sweet, 12 (Boston, Mass: Harvard Business School Press. 1991).

2 Chris Dede, Pam Whitehouse, and Tara Brown L’Bahy, “Designing and Studying Learning Experiences That Use Multiple Interactive Media To Bridge Distance and Time”, forthcoming in *Current Perspectives on Applied Information Technologies, in Distant Learning*, ed. Charalambos Vrasidas and Gene V Glass, (March 2002).2.

3 *ibid*, p. 2

dismantling. These observations were invaluable in helping us shape our questions. A list of the stakeholders that we observed and/or interviewed is listed in appendix 1.

Finally, we used an alternative research method, gathering information from students in both sections of the Running and Growing the Small Company course to survey their thoughts on the current use of technology in their learning experience via an online poll.

DATA AND FINDINGS

Harvard Law School

Since its inception in 1817, faculty at Harvard Law School bears the responsibility to provide comprehensive and enlightened training to prepare its graduates for law practice, for public service at the local, state, federal and international levels, as well as for law teaching and legal scholarship.⁴ The Socratic Method, which centers on cases that reflect real-world situations, is used in the law school to train students for their legal profession.

The faculty who participated in our research¹ include Professor Troy Bretherton, who teaches public interest law, professional responsibility, and race and gender issues in the legal profession setting, Professor Peter Vanheck teaches evidence and has an intense interest in technology and teaching, and Professor Rupert Irons who is a technological innovator and teaches torts and Internet and law. Professor Vanheck and Professor Irons are both affiliated with the Berkman Center for Internet & Society at the law school.

Founded in 1997, the Berkman Center is a research program that explores cyberspace, sharing in its study, and helping to pioneer its development. Today, the Berkman Center serves as the focal point for an international network of teaching and research faculty, students, cyberlaw practitioners, entrepreneurs and technologists engaged in innovative research projects designed to push the boundaries of current thought on law and the Internet.

Observations

We observed that ninety-five percent of the students in Vanheck's first-year Torts class brought a laptop. The physical layout of the classroom had two electrical outlets, two Ethernet ports, and a permanent eighteen-inch microphone for every two student seats. The front of the classroom had three sets of triple black boards in the middle and a barcode projector for projection onto an electronic screen as well. A video camera was clandestinely positioned in the back corner of the classroom near the ceiling.

⁴ Accessed April 20, 2002. Available from <http://www.law.harvard.edu/>

During class, as the professor cold-called selected students, we observed other students either following the discussion, writing email messages, web-surfing, and some even playing computer games. After class adjourned, students informed us that the instant messaging and the web-surfing might be course related. Upon additional questions, we learned that this particular course uses a dedicated chat-room for in-class discussion that helps students reflect and discuss a particular topic raised during the lecture. For instance, a student interested in a particular aspect of a case can log onto Westlaw⁵, research the issue, and inform other students in class via the chat tool on his or her enlightening research efforts. This in turn would spur additional insights from other classmates, and so on. Afterwards, the professor may review logs of the in-class student chat text to gauge interest in a specific topic, verify that students remained on-topic, and whether or not students were acquiring target erudition.

Since students can use their real or pseudo names within the chat room, in the beginning of the academic year, the chat-room conversations were very immature with students gossiping or criticizing other's appearance. However, as the year proceeded, and chat-room activities slowed, the conversations became more class-related. During past classes, the chat-room text was projected on one of the overhead screens, but this practice stopped when Professor Vanheck could not monitor the flow of discussion. There were also inappropriate comments made about guest speakers while the speaker addressed the class. After several incidents, the class decided to stop projecting the chat sessions.

Upon reflection, some students found the chat-room useful while others found it distracting, affecting their ability to pay attention in class. As a result, some students stopped using this forum. From Professor Vanheck's perspective, however, the in-class chat room inspires innovation, as it allows students to add information that they gather online. He views the chat room as adding momentum and dynamics, and as another way to get input into the class. The chat room provides a "panel of experts" for others in the classroom and when "things are done right" the sharing of research through the chat-room "fills in the blanks."

In addition to the in-class chat-room, law school students can access an online discussion board provided via their course platform (Blackboard). In general, students indicated that the online discussion enabled viewpoints that were otherwise unheard in the classroom, exposing them to new, diverse viewpoints. Several indicated that they had benefited from peer exchange as students interpret and approach the same questions in very different ways.

Likewise, in one particular first-year section and another elective seminar, students use a Rotisserie system to exchange ideas. The Rotisserie is a "threaded messaging" system that runs on a weekly cycle with Professor Irons posing a reading-related question to a target set of students through a

⁵ Westlaw is a research database for lawyers. Accessed April 20, 2002. Available from: <http://www.westlaw.com>.

web-page medium. The students must respond to the question by a certain deadline, then this response is randomly sent on to another student for critique. Both the initial response and critique are available to all students and guests on the course web site.⁶

In the course where participation in the Rotisserie is mandatory, students feel more at ease in voicing their true opinions online. As a student remarked, “In an environment where being asked to speak in class can be a terrifying experience, or where volunteers are derisively branded “gunners”⁷, students use the mandate as “cover” to participate without evoking social stigma.”⁸ Nonetheless, some student’s feel that various colleagues do not take the Rotisserie seriously and that affects the quality of discussion. In another course where participation is voluntary, those that use the Rotisserie system are viewed as “gunners” Thus, the rotisserie is less active.

Law School Pedagogy and its impact of learning and technology

Because the law school’s educational mission is very intertwined with the competitiveness of the profession, much of its pedagogy, including examination formats, is designed to rank students⁹. As a result, the school values sorting and rewarding people who think fast, but not always those who think deeply.¹⁰ Subsequently, a distinct pattern of class participatory behavior emerges:

The requirement to perform in a particular way in law school establishes the harshest and most adversarial version of the Socratic Method as the benchmark for success...the stereotypical Socratic approach at its worst [is] learning how to ask rude questions. Most people ask questions because they want to know the answers; lawyers are trained never to ask questions unless they already know the answer.

To the extent this occurs, the technique of Socratic teaching—in which law professors train students to “think like lawyers’ by asking individual students to answer a stream of questions in front of their peers, often “cold calling” on students who are not identified in advance—looks to many like ritualized combat. Students who do well often do so because they see this version of the Socratic Method as a game, and as in all games, they play to win....You win when you silence your opponent.¹¹

In fact, Professor Bretherton’s observation of the pedagogy and its adverse impact on class participation is supported by a law student:

Students express a strong commitment to the concept of peer learning and disagree with the idea that they have nothing to contribute to class discussions. At the same time, they show some mild discomfort with class participation, including some concern about being “wrong” (professor disapproval) or being perceived as a “gunner” (peer disapproval).¹²

6 The Berkman Center views the Rotisserie and the in-class chat-room as technologies that may be readily transferable to distance education.

7 Student Survey conducted by Harvard Law School student Gene Koo.

8 Comment by Harvard Law School student Gene Koo

9 Troy Bretherton, *Becoming Gentlemen: Women, Law School and Institutional Change* (Boston: Beacon Press, 1997), 2-4.

10 *ibid* p. 4.

11 *ibid* p. 13.

12 Student Survey conducted by Harvard Law School student Gene Koo.

Within an adversarial and self-conscious environment, technology could potentially bridge the communication gap, enable students to learn from their peers and provide them a forum where they could dissent from the class orthodoxy. When commenting on the online forum, a student remarked:

I think that in general its quite clear the hierarchy in the classroom... it just isn't open to challenge the professor or... you can say the expected, but... the professor is teaching, and the Socratic method and all these other methods just hide that fact, they know they started it and they know where they want to end up... the forum is one area where you don't have that constraint.¹³

Some faculty on the other hand, view technology as a means to change the prevailing teaching and learning model at the law school. Professor Irons uses technology to get law students to “buy into the classroom”. Since the final exam is the only determinant of a student’s grade, upper-class absenteeism is high. Those that do attend class are often “bored to tears”, as illustrated in their behavior of playing solitaire or surfing the web. This is noted by the disengagement of the law students in class, attributed to the grading system (one test-one grade, and no value for class participation or attendance.)

Given this lack of student focus, Professor Irons attempts to create a highly structured environment to engage students and ground them in course topics via the Rotisserie system and weekly polls on the course platform. This helps all students, to contribute knowledge in a non-threatening medium.

In order to motivate students in the use of these new mediums, Professor Irons, with the cooperation of the registrar, offers one extra credit for his course. This is appealing to students since this translates to one less elective requirement to complete their degrees.

In addition to the Rotisserie and polls, Professor Irons runs supplementary technological experiments to determine how to optimally delivery knowledge to students. For example, since his seminar on Internet and Law is half MIT students, and half HLS students, the skill sets from these two cohorts vary widely. MIT students are extremely knowledgeable of technology, whereas the HLS students have a deep legality based background. To keep all students engaged, his class simultaneously displays three multimedia screens at the front of the class: a “Slider Scale”, which is a barometer of student comprehension of the current topic; next, is a screen which depicts a transcript of class discussions (also available outside the class); and last, a screen for PowerPoint slides, videos, or websites that enable students less familiar with the terminology to immediately gain clarification. While this interactive system may be distracting to some students, this has helped mitigate misunderstandings in either technology or the legal topic discussed. Thus, professor Irons uniquely addresses each student’s

¹³ Student Survey conducted by Harvard Law School student Gene Koo.

educational needs, leveling the playing field. Using this class as an illustration, we demonstrate that students are driving the demand for the greater use of technology in the classroom.

Impact of Technology Adoption

Even though parts of the administration and the student body are eager to use more technology in the classroom, introducing technology into the law school has not been an easy task. As categorized by a Harvard University instructor, faculty response to the role technology in their teaching could be grouped into three categories: the orthodox, who like the past and see no reason to change; the fundamentalists, who agree with the orthodox and resent anyone who tries to introduce change; and the innovators, who like to try out new substance and are innate technical adaptors. A media technician in the law school observed that with a few exceptions, many of the professors above age fifty are uncomfortable with technology and that it is difficult to motivate them to adopt technology.

Despite some faculty hesitance, the law school has invested in upgrading its facilities, such as audio-visual and presentation equipment. To provide technical assistance the law school has three full-time and two part time media technicians and an additional coordinator. The coordinator answers professors' requests and coordinates the technicians' work. The technician feels that the law school should have six full-time staff providing the services, as he and his colleagues are often hurrying between buildings setting-up and dismantling gear after each class. For example, while professors are required to give seventy-two hour multimedia-setup notice, it is estimated that, forty percent of them call the morning of an event. Even though this behavior is against policy, the media department can not refuse to provide service for faculty. These last-minute unscheduled requirements place strain on the technicians, who must attend to other classes that use technology on a regular basis.

Graduate School of Design

The Graduate School of Design ("Design School") offers a range of master degree programs in architecture, landscape architecture, and urban planning and design. The Design School also provides opportunities for advanced study and research in these fields and in such areas as real estate, digital media and housing. The Design School's curriculum is constantly undergoing revision due to the rapidly changing demands of the design industry, emergence of new technologies, environmental considerations, and the blurring of traditional lines among design professions.

In the 1980s, under the leadership of the Chairman of Architecture, Harry Cobb, and Dean Gerald McCue, the school began a critical reexamination of the field of design. Cobb reinforced the architecture program by establishing a core curriculum centered on the studio, and by attracting exceptional and often

controversial practitioners. Specific areas that have been improved and/or revamped include research activities, scholarship funding, and instruction. Physical improvements include the expansion of the computer networks and facilities, the renovation of the Frances Loeb Library, and the establishment of several research centers (Center for Design Informatics (CDI), Center for Technology and the Environment, and the Center for Real Estate).¹⁴

Indeed, the actual architecture of the Design School reflects the studio emphasis. Studios are stacked in stadium-like layers, with each studio representing a student's individual "design area", open to other students and faculty to learn, teach, and explore. The dynamics of the studio-space allow students to share, collaborate, and observe each other's work.

Design School: Pedagogy, Students, Profession and Vendors drive technology adoption

The core of the Design School's pedagogy is the studio method of teaching. Through the close interaction with faculty in small studios and classes, students gain experience in contemporary design issues, along with an in-depth understanding of theory and history, technology and professional practice.¹⁵ In the Department of Architecture, first year students must enroll in four studios courses that introduce them to the practice of architectural design, its theoretical principles, and the physics behind architecture (Structures). The Department of Landscape Architecture also fosters students' inventiveness and creativity, and cultivates their decision-making skills via the design studio, "the core of learning and inquiry."

Technological advances have greatly simplified the work process of architects, graphic designers and engineers. For instance, programs such as CAD eliminate the drawing board and enable architects to make quick and accurate drawings, modify drafts, run multiple scenario analysis, and test their design for stress loads with the use of a computer. ¹⁶ In non-building related courses such as real estate finance, it was noted that there are benefits to having additional IT tools, as it has in the past with spreadsheet software and calculators.

Driven by the intensified use of software in the design industry, a number of the Design School's core curriculum, including those taught in the studio setting, are becoming more IT intensive. In particular, most architecture, real estate, and design students must be proficient in foundational CAD (Computer Aided Design) & GIS (Geographic Information System) software applications prior to taking more advanced Design School courses.

14 Excerpts from Harvard's Graduate School of Design's web site, (accessed April, 22, 2002). Available from <http://www.gsd.harvard.edu/>.

15 Excerpts from Harvard's Graduate School of Design's web site, (accessed April, 22, 2002). Available from <http://www.gsd.harvard.edu/>.

16 Vijay Dougal, "CADD Primer: A General Guide to Computer Aided Design & Drafting", Mailmax Publishing, New York. Accessed April 22, 2002. Available from <http://www.caddprimer.com/>.

Given the IT proficiency requirements, students are expected to provide their own computers. These computers give them access to the Design School's high-speed network (provided by the University), access to email and the World-Wide-Web, and a broad spectrum of software. Network connections and peripherals (scanners, plotters, and printers) are available throughout the Design School in every classroom, the studio's, and in the library study areas. The ubiquitous scattering of these resources is aligned with the Design School's tradition of fostering an intimate, workshop-like atmosphere for teaching, learning and working. In addition, the Design School has dedicated labs for imaging, digital video, and CAD/CAM for computer controlled machinery.

Mid-Career professionals attending the Design School, and students returning from internships, drive IT changes by requesting to utilize software used in industry to aid their studies. For instance, in 1999, Professor of Design Technology and Management, Spiro N. Pollalis, added ArchiCAD to the design network in response to requests from students who had previous exposure to the program in their professional lives, and from students who wanted to use the architectural objects contained in this software. The Design School takes pride in accepting useful industry software packages recommended by students that aid learning and improve the curriculum.

Another driver of IT innovation at the Design School has been the establishment of several research centers. Established by Design School professors, these initiatives have led to innovation that has been transferred into the Design School's curriculum. For example, the Center for Design Informatics (CDI) developed the ISM program¹⁷, a web-based online interactive course that was developed to deliver teaching content for the Design School. The first Design School course developed for this tool is a Structures course.

Based on observations, first-hand experiences as teaching assistants, and students feedback, CDI developed this learning tool that gives students access to course context across several dimensions: lecture slides, multimedia elements (pictures and video), student self assessments, glossary of course terminology, real world pictures of buildings and construction sites, and interactive graphical representations of physics formulas. The latter gives students the ability to see the formulas in action using real-life artifacts. For example, in representing vectors of force, a graphical interface shows a little boy pushing a girl on the swing set, with arrows showing the loads and a formula that changes values as the boy swings the girl.

Course content delivered in this medium helps all with various backgrounds in math and physics. This tool helps to average out the learning curve in a topic that traditionally was, on average, of low interest to Design School students. Advanced students could skip the intermediate explanations and

¹⁷ Information on ISM available from <http://research3.gsd.harvard.edu/ism>, and use guest as login.

simply review core concepts, whereas intermediate students can dig deeper and review the step-by-step tutorials, viewing examples, etc. ISM is a framework for online course content that could be rolled out to other subjects, such as art history or mathematics.

Graduate School of Arts and Sciences – Department of Economics

The graduate program of the Department of Economics (“the department”) is designed for selective students who wish to prepare themselves to teach, research, and prepare for responsible positions in government, research organizations, or business enterprises. Admission to the program is limited to candidates preparing for the degree of doctor of philosophy (Ph.D.) in economics¹⁸.

The teaching method at the department is based on lectures. The curriculum includes advanced mathematical material, rich in formulas and hard to digest at a first hearing. As a result, the form of class discussion is often limited to verification questions. In addition to lectures, students are required to complete problem sets and exams. Grading is normally based on the exams and problem sets, but never on class participation.

Students in the department are expected to read academic research papers throughout the semester. Most of these papers are available either through an online course platform or through Internet websites. Teaching assistants answer student inquiries in their office hours. From the third year and on, students participate in research seminars where discussion is encouraged, but not required.

Technology usage is not wide spread in the GSAS Economics’ department. Since the material requires an understanding of complex mathematical and technical concepts, professors must demonstrate involved mathematical models on the blackboard repeatedly. This method allows faculty to assess class comprehension of the material in real-time, and allows them to focus on concepts that students are struggling with.

The use of PowerPoint slides is avoided since instructors have found that this instructional delivery mechanism “standardizes” the learning process, and does not optimally deliver course concepts. It is not effective in teaching economics due to a need for the perpetual illustration of course concepts since the materials are dynamic and constantly evolving through research. Consequently, this indirectly creates barriers to the standardized delivery of the GSAS Economics’ department pedagogy.

Another deterrent to technology usage in the classroom is the lack of support staff available to help faculty leverage advanced technology. Many junior faculty members in the department are responsible for creating their own course web page using the Instructor's Toolkit, a central FAS course

¹⁸ Accessed April 20, 2002. Available from: <http://post.economics.harvard.edu/program/>.

construction kit.¹⁹ The kit helps instructors create a set of web pages that are common across all courses, such as an instructors' contact page, folders that allow the instructor to place course content files of reading assignments, lecture slides, problem sets, and other interactive features such as video and slide carousels.

While this tool streamlines the creation of a course web -site, instructors are unsure of how to maximize the use of interactive media that is unique to course concepts taught within the department, such as econometric modeling theories. Regarding the knowledge transfer of econometric modeling theory, the blackboard is still the predominately medium.

Lastly, in terms of physical IT setup in the Economics Department, when PowerPoint, overheads, or audiovisual for displaying statistical program software is needed, the professor must setup the needed technology him or herself.

Harvard Business School (HBS)

The business school's pedagogy relies on the Socratic Method of teaching, as does the Harvard Law School, which is an interchange between instructors and students and among students themselves. The essential premise underlying school's pedagogy is that management and leadership skills require more than the acquisition of facts: expertise is built through practice and experience.²⁰ Harvard Business School achieves this goal through cases that encapsulate real-world dilemmas posed by managers, including cases designed to convey the experience of senior business executives²¹, and challenges students to construct a course of action for the business via extensive class participation. Students are often asked to defend their position based on a specific recommendation.

For Harvard Business School, the emergence of the World Wide Web unlocked new pedagogical delivery methods and provided HBS the opportunity to streamline internal operations. Today, the school leverages the World Wide Web to deliver interactive on-line cases, pre-matriculation on-line courses, a customized course platform, polling applications, and other virtual and physical technology enhancements, both internal and external to the classroom.

The course platform in particular was constructed to both streamline the delivery of interactive and static reading materials needed to prepare for class, offers contact information to class colleagues, conveys time sensitive information, and performs several other course-related functions.

¹⁹ Information on the Instructor's Toolkit, available from <http://www.courses.fas.harvard.edu/webtools.html>.

²⁰ Dorothy A. Leonard and Brian J. DeLacey, "Case study on Technology and Distance in Education at the Harvard Business School," Working paper (Harvard Business School. Division of Research) 02-026.

²¹ *ibid.* p. 2.

Additionally, as with other Harvard Schools, videos are used in class and wireless technology is ubiquitously available around campus.

Observations

One of our first interviews was in the business school and opened many possibilities for further investigating. This professor's research focuses on women and the private equity markets, the influences and effects of entrepreneurial resource choices made at the founding of a new organization, and women as business leaders. She has had extensive experience with the use of technology in classroom, and has found that the use of videos, both through the course platform and in class, helps students increase their understanding of the business decisions analyzed and indeed affects students' responses. For example, in showing a video about a case protagonist after having a case discussion, the video showed that the case protagonist was an African American, not apparent in the written case. After realizing this fact, students viewed the case from a different perspective, as there was a now a new set of issues that the students had not observed.

Additionally, since fifty percent of a student's grade is derived from class participation, technology affords faculty the ability to help students bring their viewpoints to the classroom. For example, since Harvard Business School faculty often cold call students for their opinions, pre-class polls help the faculty member better understand where students stand on a particular issue. Furthermore, it indirectly motivates students to better prepare for class when completion of the poll is treated as part of the class participation grade. Professor Taylor has found that the use of technology, such as the polls, online videos, slides and PowerPoint presentations raises the level of discussion. According to students surveyed, some find polls useful and feel they should be used on a regular basis.

Another professor in the Technology and Operations Management area we interviewed is doing research investigating how managers can most effectively select, implement, and use Information Technologies in achieving business goals. He views the course platform as visionary for its time yet somewhat difficult to use from the perspective of the faculty member. For instance, anyone wanting to make an adjustment to the course syllabus in the middle of the semester is unable to unless the entire website is reconstructed. However, most administrators, who are usually responsible for the announcement section of the courseware, have found the course platform simple to use once they have been trained. As Irene Sharrock stated, "once you have learned the codes, which are pretty logical, the platform is quite self-explanatory."

In general, HBS students have positive feedback on the use of technology in the school. (Exhibit 2) Students feel that professors have good access to technology; yet, it is up to an individual faculty's

preference in using it. However, many expressed a desire for additional use of video, videoconferencing, and/or simulation programs that convey concepts more effectively. Concerns that students have about the use of technology center on access to course preparation materials on the course platform, and the need for an update on the email system.

Similar to the law school, and perhaps even more so, the business school has invested in cutting edge multimedia equipment for classrooms and event halls. Five audiovisual technicians are responsible for attending to campus audiovisual needs, with one dedicated to the executive education department. The mandate at HBS is to ensure the smoothest operation possible, therefore creating a “zero tolerance policy” for audiovisual problems. However, when problems do arise, they are mostly attributed to students tampering with the equipment. Thus “human error is the biggest problem”.

The majority of the requests are tightly managed by an “EMS” scheduling software so that there are infrequent last-minute requests, different than the law school. The audiovisual department is concerned about the increasing A/V needs across campus similar to the demands felt across the University. For example, they are uncertain how they will be able to handle new requests for the Hawes Hall, which contains four state of the art classrooms.

SUMMARY OF FINDINGS

Our observations revealed many differences among the schools in the following aspects: attitudes of individuals, colleges, departments and the university towards the use of technology in teaching; evolution of technology adoption; planning and support, as well as student demands on technological options available. Upon further reflection, we identified common themes that drive these idiosyncratic differences:

- 1) Attitudes and motivation behind faculty use of (or lack of) integrating greater amounts of technology in the teaching process;
- 2) Applicability to the academic discipline and technology skills necessary for one’s career choice;
- 3) Previously completed training and knowledge of technology, as well as training presently available;
- 4) Budgets of the department, college and university; and,
- 5) Time constraints of the faculty to integrate technology into their curriculum.

A Double-Edged Sword: Faculty’s attitudes and motivations could enhance or inhibit technology adoption

As coined by a faculty member, “orthodox, fundamentalists, and innovators” are all well represented in the different schools. On the one hand, we find innovators, who experiment with different types of technology and seek further improvements to existing systems to perfect their teaching. On the other, we find orthodox faculty, who do not see the need to change, but are willing to keep up with technology on a need-to-know basis. For instance, one of our interviewees at a Harvard School admitted that he would only learn and use a certain technology if there is a demonstrated need. IT staff supported this faculty statement with his/her observation that unless faculty are offered a proven, compelling reason to try new IT solutions in the classroom, they are satisfied with the existing systems. Occasionally, even if state-of-the-art technology is provided to faculty, they will only use what they are comfortable with. For instance, the control room for a large conference room has built-in slide projection equipment; yet, despite his staff informing him of the availability of the in-house equipment, the faculty member insisted that his staff bring a LCD projector and a slide projector to his class in the large conference room.

Industry driving greater technology adoption in the classroom

A graduate school’s purpose among many, is to provide knowledge and acclimate students to industry specific tools, thus preparing the them for professional success. In order to accomplish this goal, some schools’ missions mandate incorporating this technology into their curricula. This is most illustrative in the case of the Graduate School of Design where the school is introducing more technology into the classroom so that students will have a foundation of technical skills.

Technology as a tool to improve existing pedagogy

The use of technology in teaching depends heavily on the school’s pedagogy, content of the curriculum and the grading system of the school. Innovative faculty are using technology at Harvard Law School to ameliorate some of side effects of the grading system, such as low class participation and absenteeism. Through the use of online forums, polls, and the Rotisserie, faculty are promoting discussion and enabling students to learn from their peers, and hopefully engaging students in the course. Similarly, some faculties at Harvard Business School are enhancing the level of discussion through polls, online videos and other tools.

Students the critical stakeholders: main drivers of greater use of technology in teaching

Repeatedly, we found that students play a key role in promoting the use of technology in teaching. The most explicit example of their role is illustrated in the design school, when students demanded specific software that they have used in the industry, and request longer computer lab hours.

Students also instigate change when they rank the use of technology in every course evaluation thereby creating channels for future transformation. On an implicit level, as more technologically savvy students enter graduate institutions, they expect a certain degree of “technological expertise”, and technology available in and for the classroom. Moreover, as students are more prone to multi-tasking, interactive multimedia tools are become necessary to both engage students and deepen traditional knowledge drivers.

Budgetary and Human Resource Demands

As the schools introduce more technology to the classrooms, a greater strain is posed on existing support staff. In the Faculty of Arts and Sciences, for instance, eleven workers are responsible for communicating technological changes to the 700 faculty members in the school. This obviously creates a bottleneck and constricts the ability to rollout technology congruently across all faculty needs. What's more the budgetary demands of each school has a great impact on the technology available, as well as support staff for their individual schools.

CONCLUSIONS

Due to our experiences as cross-registrants among Harvard schools, we expected some differences in the use of technology in the classroom. At the same time, we also expected certain similarities in classroom configuration, the logistics of audiovisual setup, and IT support. Our study confirmed our expectations in the differences, and revealed underlying factors that lead to the variance. Our study also surprised us with the lack of similarity of classroom configuration, the process of setting up the technology setup in the classroom. Nonetheless, the schools that we visited use technology on a consistent basis and have imbedded it into their pedagogy. They acknowledge the importance of implanting technology into a school's culture, creating an environment to facilitate students' use in the classroom, industry, and the job market in general.

In the case of FAS (and in some ways in other schools too), there was a gap between technology available and what is actually in use. As stated above, this mismatch exists because of funding issues, bottlenecks that prohibited greater knowledge of technological possibilities among the faculty and occasionally, and the lack of understanding in how technology could help enhance knowledge transfer to students.

Thus, from a human resource point of view, FAS could benefit from establishing a research center, similar to the Design School's CDI, that is dedicated to developing customized technologies to

enhance learning. While impressive innovation exists within specific FAS courses, formalizing the innovation process in a dedicated research center could lessen bottlenecks and actually increase the velocity by which professors adapt new technologies that enhance knowledge transfer. The success of achieving the latter goal is dependent on resources available to the center to educate, engage and motivate faculties on their innovation and the benefits it would bring to their teaching and research.

We also find that students are an important driving force in encouraging the use of new technologies. Since students that cross-register have a wealth of knowledge on best practices in the various schools where they have studied, it would be useful for schools to consider involving cross-registrants to appraise and assist in how technology can be improved at their degree school.

Professors are not judged solely by teaching, but additionally by their research and service. These factors, and the lack of participation by the faculty member can lead to incidences where faculty do not gain advancement or promotions. However, what is quantifiable is research and scholarship, because it is measurable by the amount of publication in refereed journals, or the grants the faculty member has received, much more easily than the quality of teaching or the nature of the service activities. Presently, the only way to evaluate courses is through student evaluations. We recommend an incentive program, where applicable, tied to the Provost's or Dean's office, that would reward creative, and innovative usage of technology in the classroom to enhance the learning experience of students across the University.

Additionally, IT departments within individual schools have an acquired knowledge base that if embraced, could lead to further enhancement in the current use of technology across schools. Yet, in our research, we have seen few instances of technology actually being shared among the schools. For example, the business school may benefit from the use of the Rotisserie system used at the law school. While the Department of Economics may find the ISM program that CDI is developing useful in helping students in reviewing their materials. Thus, schools can benefit from a systemic exchange of information on the use of technology in and outside the classroom. Clearly, the Design Advisory Group²² is working to achieve this objective by sharing "faculty innovation and pedagogy ... and best practices." We suggest a formalized cross pollination effort, supported by the Provost Office, to ensure greater knowledge sharing. This top-down approach, upheld by student demands, will build toward greater changes and opportunities for all stakeholders.

²² Accessed April 22, 2002. Available from: <http://icommons.harvard.edu/html/icommonsgroup.htm>

Exhibit I: Interviewees, Contact Information, and Poll Sources

Interviewee	Email / Phone	School	Function
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Names removed for privacy purposes...

Exhibit 2: Poll Data – Responses from 19 students from RGSC Sections 1 & 2

#1) Do a majority of your professors use technology to help you **prepare** for class? (E.g. case discussion questions available on your course home page, polls, videos, etc.)

Yes	14 responses
No	5 responses

#2) In preparing for class, how beneficial are the tools available through your course home page? (videos, polls, discussion topic questions, chats, etc.)

1. do not use	0 responses
2. not helpful	1 responses
3. ok, no change necessary	6 responses
4. helpful	9 responses
5. very helpful	3 responses

#3) Please rank the extent to which this preparatory technology helps you learn course topics.

1. the technology not at all helpful	0 responses
2. technology helps to a certain extent	5 responses
3. the right amount of technology is used	8 responses
4. more technology should be used	6 responses
5. the school is not doing enough to integrate technology	0 responses

#4) How do you find the current use of technology in the classroom?

A. not at all helpful	0 responses
B. somewhat helpful	4 responses
C. ok, no change necessary	5 responses
D. helpful	8 responses
E. very helpful	2 responses

#5) Would a greater use of technology (by the professor) within the classroom be useful?

1. no, not at all	2 responses
2. no, less than current is needed	0 responses
3. ok, no change necessary	8 responses
4. yes, a little more is needed	5 responses
5. yes, the school should use much more technology	3 responses

#6) Do a majority of your professors use technology in the classroom?

Yes	12 responses
No	9 responses

#7) Please indicate your school.

HBS – all 19 responses

#8) What specific technological changes would you like to see to enhance your learning experience at Harvard?

- “More simulation type of exercises”
- “Interactive communications tools. Collaboration tools for group projects Presentations”
- “I really do not believe technology would help us learn more in the classroom. It makes things easier, but does not contribute enormously to learning. Only videos are of great help.”
- “Following valuation models more easily”
- “more videos life polling during class”
- “simulation programs, videos”
- “I think profs have good access to technology and it's up to them to use it. Most of them do a good job.”
- “More use of technology in the classroom. Videoconference, video, etc.”
- “More discussion boards for class follow-up discussions.”

#9) Any other comments regarding the use of technology @ Harvard?

- “i miss wireless in the class room”
- “I think that the use of technology at HBS has been used for administration purposes with great results (myHBS, news, etc.)”
- “they do a pretty good job but can do even better”
- “Check Management in Perspective. They used Webex every week and we had several polls and discussion board sessions. Also, Customer BEhavior Laboratory: interactive cases.”

Exhibit 3: Interview Questions

Examples of Questions We asked Faculty, IT, and Students and Administration

Questions Posed To Faculty that we Interviewed.

- “Tell us about how do you use technology?”
- “How does it (what example they gave us) affect your teaching?”
- “Does this (what example they gave us) impact learning?”
- “Why do you prefer this tool or other tools?”
- “How do the students react to this tool?”

We received a variety of responses to these questions, which generated lively discussions. Additionally, it lead to more questions, and expansions of the themes and suggestions of more people to interview. There were a wide variety of responses among the different interviewees.

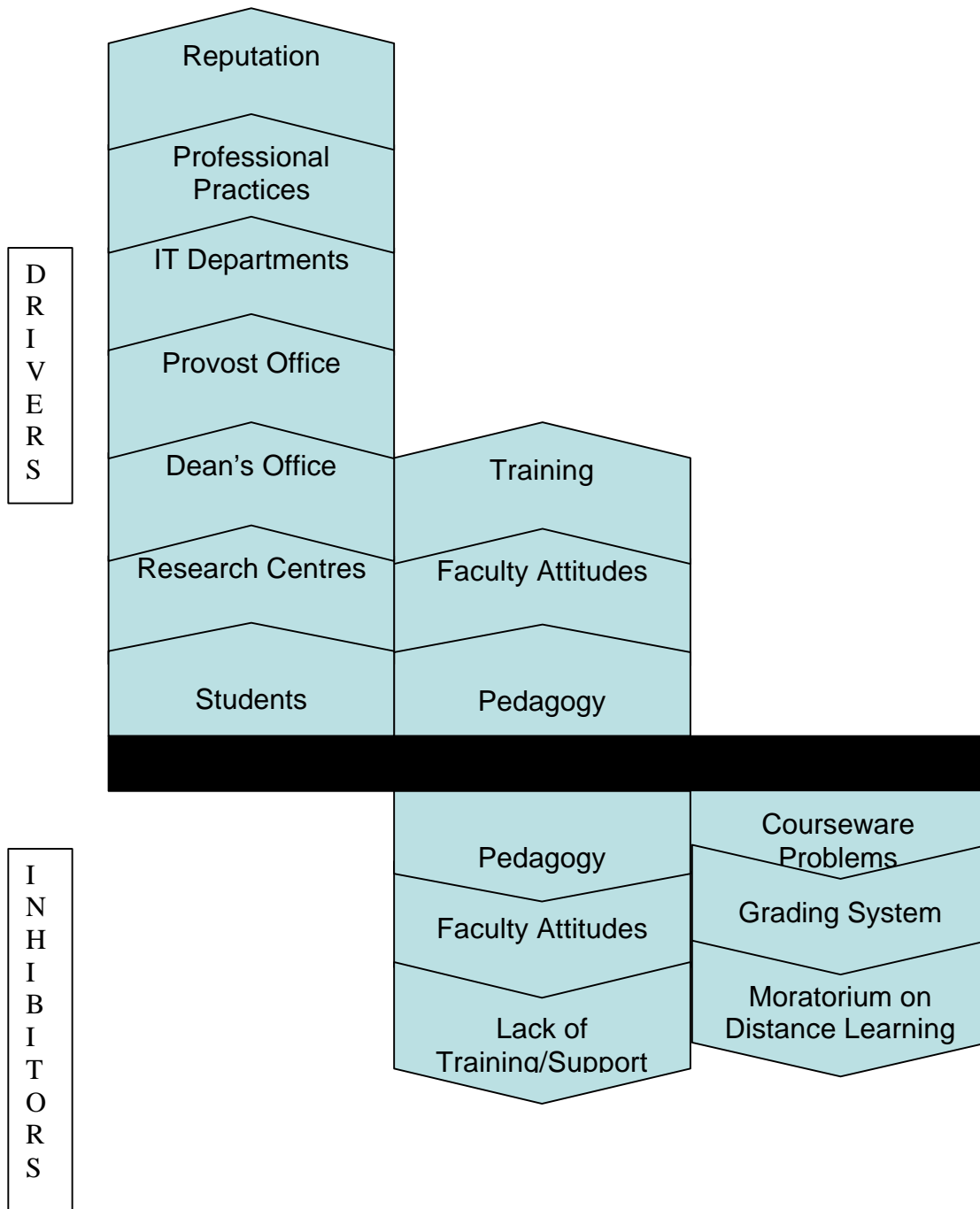
Questions posed to IT personnel during interviews.

- “What type of services do you provide to the teaching faculty?”
- “What types of technology seem to be the most common in teaching at the school?”
- “How are professors informed about new possibilities of technology usage in teaching?”
- “How many staff members assist how many faculty members?”
- “Do you see as any the barriers in the faculty using technology to teaching in your school?”
- “How do new technological tools assimilate into teaching at your school??”

Students interviewed were asked questions the following types of questions.

- “Is technology a part of your experience at school?”
- “What type of technology do you use or experience inside and/or outside the classroom?”
- “Do you feel this technology affects your ability to understand the subject?”
- “Do you find it helpful or distracting?”
- “Does it affect the class dynamics?”

Exhibit 4: Drivers and Inhibitors of Technology Adoption @ Harvard



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¹ Note: Instructor names are masked in this report.

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Available from <http://www.law.harvard.edu/>

Information on ISM available from <http://research3.gsd.harvard.edu/ism>, and use guest as login.

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