Infrastructure for Embracing e-Technology in an Academic Department

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Abstract

The logistics of implementing e-technology in engineering education require investments not only on the physical resources but also on getting all the constituencies involved in the process. At the University of Pittsburgh, the Department of Civil and Environmental Engineering invested a sizable sum in building a technology classroom to bring the department up to state-of-the-art level in e-instruction. This involved constructing a facility which seats a class of 60 students and providing 31 high-end desktop computers so that every two students can share one machine and participate in interactive learning with the instructor. After the hardware was installed, several more requirements had to be addressed. In a classroom in which students are expected to take courses in a variety of subjects as part of their program of study, software that is relevant to each of the courses must be purchased and site licenses arranged for group use. Instructors must have the requisite skills in e--technology in order to take full advantage of the capabilities of the facility. These include putting course material together in e-deliverable format and the electronic posting of course material and homework assignments. A training program for this must be developed. In order to advance to a level of full immersion in e-technology, educational institutions must have these resources in place.

I. Introduction

If an academic program really wants to take advantage of e-technology to deliver a full instructional program, it is important that the use of the tools of the trade be available for most, if not all, of the courses in the program. All students must have access to the technology not only through personal computers for their assignments but their classroom must also be e-enabled so that a student's work which has benefitted from access to information technology outside of the class could be used interactively with his instructor and classmates when he brings his work to class.

For an academic department which offers close to thirty courses in each semester of the academic year, this requires a dedicated facility which is equipped with the requisite tools for e-instruction. Once this facility is built, the academic program must be able to control its use especially in the scheduling of classes so that the logistics of delivering e-instruction can be addressed locally. Delays in instructional delivery due to equipment malfunctions can be addressed immediately instead of having to depend on the bureaucracy of a larger academic administrative unit.

We differentiate this approach with programs in many universities wherein media-enhanced classrooms are made available to the faculty by special request. The logistics for access to such media-enhanced classrooms differ from a dedicated facility for multiple courses in a specific program. As will be explained below, specialized software is also needed. This is also different from special laboratories which are set up for long distance learning. Our facility is being used for on-site class instruction.

At many universities, there are two approaches to bringing information technology to the classroom. In one model, usually because of resource limitations, equipment is shared by several classrooms. For easy access by instructors portable video and audio-visual equipment are kept in audio-visual closets located in several places throughout a building, typically one in every floor. These AV closets are equipped with card key locks for direct access by instructors through the use of their university ID cards. They are able to take out equipment that they need and bring it to a classroom which must have the necessary ports to connect to data networks. In the other more expensive approach, some universities have built technology classrooms, strategically located across the campus, where classes may be scheduled by instructors wishing to use the technology. These media-enhanced classrooms are typically configured to have one video projector that can handle high resolution displays; a suite of equipment which includes VCR, DVD, and a document camera; a wireless public address system; a media control system operated via a touch pad that integrates the operation of AV equipment, screens and lights; active data jacks to facilitate connecting equipment to campus data and video networks, equipment rack layouts for accessibility. A university-wide technology support office is responsible for

maintaining all the facilities in these two approaches. Universities have developed facility maintenance systems wherein the status of each technology classroom can be monitored efficiently to ensure that everything is in order. Support services for technology classrooms usually include a local manager as the point of contact for users, a "hot line" that is staffed with trained technicians, hard copy and on-line documentation and training materials, and support for maintenance and repair.

While all of these services may be provided by the university, in a classroom which is basically dedicated to the exclusive use by the faculty of a single department, many of these functions must be assumed by the department.

II. Dedicated e-Teaching Faculty

In the School of Engineering at the University of Pittsburgh, the Civil and Environmental Engineering Department is fortunate to have been able to experiment with the construction and operation of a dedicated technology classroom, solely for the use of the department. Of course, other units of the university may also use the facility on "when available" basis. This experiment on autonomous facility management is the result of a conscious program by the School, with the support of the university administration, to encourage to bring e-technology into the classroom.

Foremost among the requirements to do this is the availability of capital resources to construct the facility. The CEE Department at the University of Pittsburgh is medium-sized. In the sophomore, junior and senior years of the civil and environmental engineering program, the department has 180 students, divided roughly equally among the three upper-level years with a slightly lower number in the senior year because of attrition. Thus, in order to accommodate the average class size for the fundamental courses in the program, it was decided to build a technology room which would seat 60 students and which is equipped with 30 computers plus one for the instructor so that every two students share one machine, not only to access data networks and course materials but also to work interactively with his classmates and the instructor.

Building the classroom is just the first step. In order for this facility to run efficiently, several issues need to be addressed. These include software and its maintenance and periodic upgrade, trouble shooting repair and maintenance of the hardware, preparation of instructional material, e-literacy of instructors.

A. Capital Investment and Hardware

Finding the physical space to build a high-tech teaching facility can be a problem in an urban university. We needed space to house a class of 60 students and install 31 high-end desktop computers that are networked for interactive learning. In an urban university where space is at a premium, this was achieved by demolishing two adjoining classrooms, redesigning the layout of desks and instructor's station, putting up the appurtenant fixtures and completely rewiring the room through a raised floor system to accommodate the computing and audio-visual equipment. The classrooms had to be released from the room inventory which is controlled by the University Registrar who schedules all the classes for the university. While most of the demolition and framing were done during the summer, construction extended into the fall term and therefore classes which were previously held in the demolished classrooms had to be rescheduled elsewhere.

The department was fortunate that a group of alumni agreed to raise most of the funds to have the classroom constructed. The university also agreed to share part of the construction cost. Alumni who are in the design and construction business agreed to donate architectural design services, some electrical and mechanical supplies as well as the cost of labor to build the facility. The department was responsible for the purchase of the computers which included high-end Pentium machines with flat screen LCD monitors installed in recessed openings on specially designed desktops so that the students' field of view toward the projection screens is unobstructed. Audio and video equipment including VHS and DVD, document reader and dual-retractable screens all controlled from the instructor's station. Seating was arranged so that students have a clear view of dual retractable screens which are controlled from the instructor's station (Figure 1).

B. Software

After the hardware was installed, several more requisite tasks had to be addressed. In a technology classroom in which students are expected to take courses in a variety of subjects as part of their program of study, software that is relevant to each of the courses must be purchased and site licenses arranged for group use. The department, although medium-sized, offers six areas of concentration. These are construction management, environmental, geo-technical, structural, transportation and water resources engineering. Commensurate with the advanced tools that the new facility provides, courses in the six areas of concentration must have access to state-of-the-art software so that design applications can be taught and examined using the now available information technology.

Included in the instructional software that we needed were: Primavera Project Planner and Expedition for construction management, Algor and STAAD/Pro for structural engineering, HEC-HMS, HEC-RAS and WaterCAD in water resources, Highway Capacity and Transyt for transportation, ModFlow and FracTran in environmental engineering. Site licenses for the software were acquired and the programs were installed in a server which permits access from all the machines in the classroom. In addition to specialized area software, commonly used programs such as AutoCAD, ArcView GIS, spreadsheet and word processing

Figure 1. View of classroom from the rear.

software must be made available to students using the classroom. Spreadsheet and word processing usually come with the computers and some software are free to the public but they have to be installed and maintained in the local network.

The requirements for interactive learning also required software which permits the exchange of ideas between the instructor and the students and among the students themselves. This was achieved through the installation of a proprietary software package wherein the instructor is able to grab the image on any of the students' monitors and project it on the retractable screens for class discussion. The instructor is also able to switch on or off all the students' screens from a touch pad on the podium (Figure 2). This might be necessary if he would like the students not to be distracted by what is displayed on the students' monitors.

II. Faculty Expertise

Embracing e-technology in engineering education requires investments not only on the physical resources but also on getting all the constituencies involved in the process. After the hardware and software needs have been addressed, it is important that faculty members who teach the courses possess the requisite skills in e-instruction. In a department where the teaching faculty includes tenured faculty members who have relied on the blackboard and overhead projectors in the last decades, a training program for the use of media-enhanced classrooms is necessary. For professors who have been in the department prior to the advent of applications of information technology in the classroom, putting course material together in e-deliverable format can be daunting. Even younger faculty members can benefit from refresher programs on the techniques of teaching using the tools of information technology. As in many universities, the University of Pittsburgh has a Center for Instructional Development and Distance Education. In addition to providing support for distance education courses, the Center provides training to faculty members who would like to take advantage of media-enhanced classrooms to teach their courses and transfer their classes to the Web. The electronic posting of course material and homework assignments are facilitated by software that are now generally available commercially. The Center has adapted the Blackboard course management software in implementing a

Figure 2. Instructor's station showing audio-visual controls, document reader, VHS, DVD and computer controls.

system called CourseWeb. The Center regularly schedules training seminars for novices as well as advanced users which help the faculty develop Web-based course materials. In addition to the dedicated facility in the department, the University of Pittsburgh has several Web-enhanced classrooms operated under the two models discussed earlier. In the School of Engineering, two other dedicated classrooms are run in an autonomous manner.

III. Support Services

Needless to say, for a Department to support e-instruction for all its courses, it must have adequate technical support for the teaching facility. There is a technical support group in the School of Engineering. Its technicians and staff members ensure that all computing equipment in the School is properly maintained. This is an outcome of the need to augment technical support services which cater to all the segments of the university. In a sense, the need for technical support service for the department is an extension of the School's need. Where individual faculty member's requirements cannot be met by the School's support infrastructure, the department must supply them. This support function generally does not require a full time technician and the department can share the services of a staff person whose primary responsibility may be to support the separately budgeted research projects in the department. At a minimum however, a graduate student assistant should be assigned to service the routine needs of the dedicated classroom. At Pitt, this arrangement has worked quite well. Minor troubleshooting which instructors often require is generally supplied by graduate student assistants, as well as departmental staff, who are on call.

IV. Costs

Construction of the classroom started in March and it was put into service in September of 2000. The breakdown of the total cost in 2000 US dollars: $420,000 for demolition and construction; $72,000 for hardware; and $26,000 for software licenses. During the first year of operation there was minimal maintenance cost because repairs were covered by warranty. In the second year, maintenance and repairs required a budget of $8,000.

Not included in the construction cost are architectural design services which were provided free of charge and donated

construction materials. The classroom was designed to follow the principles of green and sustainable construction so that some special materials were donated by suppliers who wanted to promote their products. These included floor coverings, recycled aluminum panels and other decorative materials. Of the total costs, the construction cost would most likely increase because of inflation but hardware cost could be significantly less with the continually decreasing prices computer equipment.

IV. Conclusion

The project has permitted the department to make a quantum leap into e-education. The availability of a technology classroom has accelerated our program to get the whole faculty involved in making full use of information technology for instruction. Admittedly, our faculty does not yet have "100 percent compliance" but the dedicated classroom has accelerated our program. We feel that this significant investment in bringing e-technology to the classroom was very much worth it. The quasi-autonomous model that we have adopted, that is, setting the technology classroom up to be almost completely independent of the technology support structure of the university may not be the most economical approach. It has, however, paid dividends in terms of the freedom to innovate and the efficiencies that were achieved in resolving many of the bothersome problems inherent in a centrally managed facility.

Author's Biography

Rafael G. Quimpo is Professor and Chairman in the Department of Civil and Environmental Engineering at the University of Pittsburgh. He teaches undergraduate and graduate courses in hydrology, hydraulics and stochastic modeling of water resources systems. His research projects has included studies on the reliability of water distribution systems, watershed modeling, applications of geographic information systems in civil engineering. He has been active in engineering education and has chaired national committees on education and research of the American Society of Civil Engineers. He is currently chairman of the Education and Research Council of the Environmental and Water Resources Institute (EWRI), ASCE.