AC 2008-2331: NOVEL TECHNOLOGY FOR ELECTRONICS INSTRUCTION – AN ELECTRONICS STUDIO

Arunachala Nadar Mada Kannan, Arizona State University
  Research focus is in the field of Alternative Energy Technologies, more specifically in fuel cells. Developed a brand new undergraduate course on Electronics projects and has been using the e-Studio as an effective teaching tool.

Barbara Rempel, Arizona State University, Polytechnic campus
  An Educator in the field of Electronics Engineering Technology for the past 17 years. Currently involved in creating electronics embedded systems concentration for the undergraduate degree program. Her expertise involves, design and development of electronic circuits FPGA systems validations, etc.

Lakshmi Munukutla, Arizona State University

Bert Valenzuela, Arizona State University
Abstract
Arizona State University’s Polytechnic campus recently received funding from the National Science Foundation (NSF) under the Advanced Technology Education Program, or ATE grant, targeted for curriculum development. The program described in this paper is the development of an “eStudio”, to facilitate effective course delivery and cooperative learning in both the BS and AAS programs.

The age-old format of separating lecture and lab in Engineering and Technology curricula has many drawbacks given scheduling and classroom constraints. With the shift toward a more non-traditional student population, students are seeking courses taught in a streamlined fashion, preferring to complete weekly meetings in one day, if possible. The compressed format makes it even more imperative to diversify the experience in the classroom in order to heighten motivation, and facilitate learning. The eStudio (See Figure 1), is a very new project within the department. The goals for the program are multifaceted and include promoting collaboration among the students, facilitating continuous improvement of the curriculum, and providing for distance learning. The biggest hurdles to clear are limited space, the diverse educational objectives among the faculty, and a limited budget. Though the eStudio has not been used long enough to provide concrete data regarding its impact, some obvious results early on include a greater presence of students in the lab during non-class hours and a heightened interest in collaborating with fellow students and faculty. To get a greater sense of impact on student learning, the department is collecting data regarding the use of the lab, the number of projects and the type of projects generated per semester as a result of the lab, as well as the progress of our distance learning efforts. We expect to be able to furnish more empirical data regarding these findings within the first two to three semesters of its use.

Immediate Goals: Collaborative Learning Enhancement, Retention
The Electronic Systems Department is small, but growing. In one year, our department has grown by 26%. The retention rate for undergrads has been increasing over the last few years, and as of last year the data indicated a retention rate of 87.5%, which is an attractive statistic. However, because the department is growing, this trend in retention and improvement in performance will not continue without deliberate actions. The challenge for the academic department is to overcome the problems that arise when growth occurs, but human resources and funding for updating facilities cannot keep pace. In the quest for more effective and efficient learning situations for students, to both improve student performance and increase retention rates, both course content and delivery methods are in a state of perpetual evaluation and modification. Pursuant to these objectives, the department determined the need for a greater emphasis on collaborative learning, eLearning, and distance learning, and a departure from the traditional lecture/lab format.
In the process of transitioning from the more traditional course delivery method to one of a more flexible collaborative learning environment, it became clear to the committee that the first target of our vision was the need for updating and reconfiguring some space within departmental facilities. The core electronics project lab was chosen to become the new eStudio Laboratory, targeted for many improvements. The lab had been functioning adequately, but by the standards envisioned by the committee and the department, it was quite lackluster. It had become a repository for equipment used quite infrequently, and a veritable storage space for odds and ends that had been donated, cast off by industry, faculty, and other donors. Few were eager to discard or find a more permanent storage location for these cumbersome items, and only after the committee unveiled its vision for the new space did the separation anxiety begin to dissipate, leading the way for the new space to be created.

To leverage the invested efforts of successfully designed project spaces on campus, the committee examined the General Engineering Department’s Design Studio Laboratory. What was observed was an environment much like what the department had envisioned for our lab space. The laboratory/classroom setting was structured in a square configuration with computing stations and student desks along the periphery of the square. In the center of the room were several large tables where students gathered to work on their projects. A class was in progress, and it was obvious that the setting itself was instrumental in fostering the collaborative learning that was under way. A very large projection screen for the instructor was toward the back of the room, where it was visible from all workstations. The room was networked in such a way that the instructor had access to and control of each student’s computer workstation for purposes of modeling, coaching, and, in general, managing instruction with performance feedback. The environment appeared to be ideal for fostering collaborative learning, and a model that would be worth emulating for the Electronic Systems Department eStudio. The only problem was the price tag. The biggest challenge would be economy and resourcefulness.

The aforementioned ATE grant supplied the catalyst for the development of the lab, and although there was a small budget for furniture, carpet and paint, some creativity was necessary to find the balance of furnishings and to implement a “knock-off” version of the technology. The committee and the department chair put the emphasis on the development of the technology components of the studio, understanding that it would be an evolving project. The phases of development would first target collaborative learning, then distance learning, and ultimately, the goal would be to achieve a Remotely Interactive Laboratory with some of the capabilities of model programs such as the one in place at L’École Polytechnique Fédérale de Lausanne (EPFL), in Switzerland [1] and that of Northern Alberta Institute of Technology and Athabasca University’s teaching laboratories [2].

Implementation of eStudio
By the end of the spring semester of 2007, the plan for eStudio was in place. It consisted of one large room separated by a 7’ tall room divider. The front half of the room was designed as a computer area suitable for instruction and conferencing (See Figure 2).
Colorful carpet squares in the ASU colors were installed, and a large conference table was purchased for the center of the room. Eleven student computers were installed in a square configuration around the space, creating the open collaborative feel to the environment. In the other half of the room workbenches with electronic test equipment and student computers were rearranged from a stacked row arrangement that had limited capability for student interaction to a square configuration with tables in the center to foster student collaboration. The two rooms together were to provide the ability to do computer simulations and hands-on work in the same area, ideal for group work where a project can be divided into components for later group integration. Concerning the technology, the initial phase of the lab development included a teaching station connected to a large projection device that displayed the instructor’s desktop and the ability for that projection device to display the desktop of the Windows XP student computers.

The original laboratory space the committee sought to create, modeled by Studio 90 in the engineering department is made up of 10 student computers with an instructor workstation. It has 11 hard wired VGA and audio inputs by each station that link back to a Crestron control system [3]. The instructor has the ability to select the station he or she wants to display on the LCD projector and other plasma TV monitors throughout the classroom by selecting the station on the Crestron touch panel that is located at the instructor’s station. The cost to implement this project was about $35,000 with an annual maintenance cost of approximately $2500 for projector bulbs and electricity.

The Studio 90 is a pristine environment; however, one drawback is that the University had to install much infrastructure to produce a clean look to the students and faculty. For example, there is a back room that contains a large rack with hardware that produces a lot of heat and consumes much electricity. Also, the University’s IT Department may not be
able to directly support this without calling a contractor and paying approximately $150 - $500 per service call. Based on this, an additional requirement, when planning the eStudio Laboratory was that it be as hardware free and easy to support as possible.

In an effort to achieve the same outcome as the General Engineering Department’s Studio 90 environment, the eStudio Laboratory Planning Committee creatively did more with less. First, the original look and feel of the space prior to renovation was stale and industrial. It was not a collaborative space that students would choose to congregate in or study. The room’s white walls were painted yellow and the grey linoleum tile was overlaid by red and yellow carpet. The final product is a collaborative teaching space that is attractively decorated in Arizona State University’s colors. It promotes University pride, spirit, and is one of the most attractive rooms at ASU’s Polytechnic campus. The eStudio Laboratory planning committee considered several options before implementation. Amongst them were the hard wired Crestron control system, a Windows Server 2003 environment with Remote Desktop, and other hardwired solutions. Only Danware’s NetOp School met and exceeded the requirements [4].

Obtaining computers was another challenge. There was no funding to purchase new computers. Instead, the planning committee utilized ASU’s Polytechnic campus centrally supported site/classroom obsolescence plan. The campus adopted a student computer lab/classroom obsolescence plan that encourages the central IT department to purchase high end computers brand new so that the computers will have a six or seven year life cycle. The first years of a computers life cycle is spent in a public computer lab or classroom. After the fourth year, they are retired and departments can apply to receive them free of charge from central IT. The planning committee requested and received nine computers that still comply with current technology standards by running Windows XP efficiently and departmental applications such as PSpice and Matlab 2007. These computers are more than sufficient to run departmental applications for years to come.

The photographs below show the set-up of the eStudio along with the students’ work area.

ASU’s Electronic System Teaching Lab is made up of an instructor computer that is connected to a 62” plasma monitor. All computers have NetOp School loaded on them and are connected to the University’s wireless network. The student stations use NetOp School Student and the instructor’s station uses NetOp School Teacher to communicate with each other via TCP/IP. Also, Danware provides a free directory service that enables the teacher and student stations to find each other. Faculty use the NetOp School Teacher utility to connect to the students desktop and display what the student is working on or presenting on the plasma monitor for the entire class to see. NetOp School provides the option to set up a directory service should Danware’s not be available.

NetOp School exceeded expectations by being simple and cost effective to implement, is scalable, comes with excellent tech support, and allows for more options than a hard wired setup. Compared to the Studio 90, the Electronic Systems Department was able to implement their teaching lab at a tenth of the cost. Because this is a software solution, there are no expensive control systems, equipment racks, and cabling infrastructure. The
Lab is energy efficient and environment friendly because it does not utilize extra equipment. Also, because it uses a plasma monitor versus a LCD projector, the image quality is slightly brighter at a fraction of the cost due to being more energy efficient than a projector and not requiring filter cleaning and bulb replacements (standard price of bulbs are about $350).

The attractive room succeeded in creating a place where students want to learn. The next goal was to emulate the robust technology in the Studio 90. Crestron is great, but too costly. NetOp was a perfect fit at tenth of the price. Its implementation provided its own challenges. This was not due directly to the NetOp School software directly, but because there is not wired Ethernet installed in the room. To install an Ethernet infrastructure in the walls of the eStudio could cost as much as $5000. Instead, the planning committee chose to use the wireless network.

Part of the efficiency is that the eStudio committee plans to take full advantage of ASU’s new online application services that provide potentially hardware intensive applications such as Matlab via Citrix Presentation Server [5]. Also, instead of using a high end ceiling mounted LCD projector and screen, the committee decided to purchase a slightly more cost effective Phillips 62” plasma monitor with digital input (DVI). The decision to go with DVI was better for the long term, but the computers provided through the campus’s computer obsolescence plan only had a RGB/VGA output. This provided many challenges. The committee spent several weeks attempting to creatively upscale a VGA signal to HDMI/DVI. The result was a very fuzzy picture on the plasma monitor. Ultimately, the committee obtained funding to purchase a new Dell computer with a
digital capable video card. The new instructor computer provided a beautiful image on the plasma monitor for the students.

A final major savings of the project was that the implementation team utilized campus IT support to consult for the project. This was an approximate savings of three to five thousand dollars. The primary long term advantage of using local support is that since the local IT staff participated in designing the room, they know how best to support it without having to call for outside help. This saves time and money in the long term.

**Future Plans for the eStudio Environment:**

The NetOp School environment is scalable because a student can bring his/her laptop into the teaching lab, install NetOp School Student, and the faculty member can display the student’s laptop on the plasma monitor. If needed, the faculty member can use NetOp to distribute files to the students, including those on laptops, from the instructor’s station. Since the future of student computing is mobile, primarily by each student having his/her own laptop, the EStudio Laboratory is an ideal teaching environment. There are few limits and it can theoretically be expanded to having a student attend class from home and the instructor can display the student’s home desktop on the in class monitor. The instructor’s environment can be expanded to use technologies such as Illuminate, Breeze, and Windows Live meeting to enable students to attend class remotely, but still be able to see what is happening on the instructor’s station. As seen from the figure 3, the plan is to make eStudio into a Remote-Interactive-Learning environment. Through this, students attending class remotely from other ASU campuses or other places in the USA or in other countries can see what’s being displayed on their peer stations via what the instructor displays using NetOp School.

**Conclusion**

The overall eStudio Laboratory project brought all who worked on and funded it out of their comfort zone because it was uncharted technological territory for all involved. The outcome is a cost effective solution that surpasses the Studio 90 because the eStudio Laboratory is scalable for the future and will soon be ready to support remote interactive learning where students tens, hundreds, and thousands of miles away can benefit from it.
References:


