

# Interactive Distance Learning: The Virtual Studio Classroom

Bradford C. Lister

Professor of Biology and Information Technology, and  
Director, Lois J. and Harlan E. Anderson  
Center for Innovation in Undergraduate Education  
Rensselaer Polytechnic Institute  
3119 Center for Industrial Innovation  
Troy, New York 12180  
[listeb@rpi.edu](mailto:listeb@rpi.edu)

Rensselaer's studio teaching model has transformed its on-campus learning environment. But how can we emulate studio at a distance and allow off-campus students to realize the benefits of interactive learning? This paper describes an innovative series of distance learning courses developed by the Anderson Center for the National Technological University. The first two courses, *Hands-On Multimedia* and *Hands-On World Wide Web*, combined satellite broadcasts with synchronous web-based tutoring sessions and asynchronous hands-on exercises conducted via the Internet. *Hands-On Multimedia* was purposefully limited to 100 students at six downlink sites. But *Hands-On World Wide Web* attracted over 8000 participants at 500 sites in the United States and Asia. The technologies utilized to create these virtual studio courses, including WebCT, I-Net, Citrix Winframe server, and MS Internet Information Server, are discussed along with teaching methodologies. Some of the lessons learned from this pilot program, and their implications for the future of interactive distance learning, are analyzed.

Keywords: interactive learning, distance learning, virtual studio classroom.

## **Introduction**

Over the past year, Rensselaer Polytechnic Institute has established three interconnected strategic directions: Interactive Learning, Information Technology and the Global University. This article describes a series of pilot courses, developed at the Anderson Center for Innovation in Undergraduate Education, that combined Rensselaer's on-campus, studio model of interactive learning with the much less interactive model of satellite-based distance learning. These new "virtual studio" classes are part of an ongoing effort to create both new content and new delivery methods for our Global University initiative.

I begin with a brief description of studio teaching at RPI, leaving out many details since this material has been covered elsewhere (Wilson, 1994; Wilson, 1997). I then describe the development and delivery of two National Technological University short course that constitute the fullest implementation to date of our interactive distance learning model. Finally, I summarize some lessons

learned regarding the technologies and methodologies utilized in these pilot courses and discuss future implementations of the virtual studio classroom.

## ***Interactive Learning at RPI:***

### **The Studio Model**

The recent Carnegie Foundation report is only the latest in a series of indictments of undergraduate education in United States colleges and universities. In 1996, an NSF study of science, mathematics, engineering and technology education reached similar conclusions, finding that 75% of students across the country evaluated their teaching as "poor" and a major reason for leaving the sciences.

In 1994, Rensselaer launched a campus wide effort to re-engineer its undergraduate curriculum. Realizing the shortcomings of the traditional lecture oriented classroom, and determined to provide its students with the best education possible, RPI chose interactive learning as the foundation of its educational reform efforts. Starting with introductory physics and calculus courses, RPI proceeded to transform its curriculum by employing a hands-on, learning-by-doing model of education that emphasizes what students do rather than what the instructor says. This methodology has come to be known as the RPI Studio Model.

The essence of studio teaching lies in the increased interaction at all levels of the student learning experience: from computer-based discovery learning to peer-to-peer interactions in learning teams to one-on-one discussions with their instructors as they work through course projects and classroom exercises.

### **Enriching Satellite Education with Interactive Learning: The Virtual Studio Classroom**

For over 10 years, Rensselaer's distance learning branch, RSVP, has delivered high quality graduate and continuing education to distant locations. Currently RSVP provides master's degrees to more than 900 students at over 60 industrial locations each semester while also offering non-credit courses for working professionals. In order to meet the challenge of its Global University initiative, RPI has begun an ambitious expansion of RSVP's curriculum, student body and geographic reach. New courses and curricula will be delivered to the US Navy, to IBM and other high tech companies, to high schools students taking advanced placement courses, and to corporate and university sites in Central and South America and the Pacific rim.

RSVP rose to national prominence based on a traditional model of distance learning via broadcast television and video tape. Influenced by its successful studio courses, however, RPI has developed a new model for interactive distance education called *distributed-collaborative learning*. This unique model emulates our on-campus studio teaching environment by connecting off-campus students, RPI instructors and educational resources together in rich, interactive learning communities. Using new technologies for web-based instruction, students can take advantage of asynchronous exercises and support, while also enjoying the proven benefits of team learning and synchronous tutoring.

Over the past year, the Anderson Center, working in collaboration with RSVP, has conducted a number of pilot courses implementing the distributed-collaborative model. In July, 1997, the Anderson Center used digital videoconferencing and interaction over the Internet to deliver a three day distance learning course with the University of Pittsburgh on *Teaching Math, Science and Engineering in a Distributed Learning Environment*. In September, 1997, I and Bruce Laplante, associate director of the Anderson Center, taught a short course for the National Technological University, *Hands-on Multimedia*, that combined satellite broadcasts with asynchronous hands-on exercises and live, interactive instruction over the World Wide Web.

Since this initial course was a pilot employing a number of new technologies, we decided to limit the enrollment to 100 students at six down link sites in the eastern United States and Colorado. Despite our worst fears, the course, was very successful and we created and taught a subsequent course, *Hands-On World Wide Web: Spinning Your Own Site*, in February, 1998. This course was delivered to some 8000 students located at over 500 NTU sites throughout the United States and Asia. Here I discuss the development and delivery of these two courses.

## Technologies for Interactive Distance Learning

Lack of interaction with instructors and other students has long been a drawback of traditional distance learning courses, whether they are delivered via broadcast video or home study. Starting in the late 1970s and early 1980s, a number of researchers began to add asynchronous computer communications and synchronous interaction via two-way cable television and audio graphics to traditional distance learning technologies. These studies indicated that interaction greatly enhanced education at a distance with improved attitudes, earlier completion of coursework, better performance on tests, and greater retention all cited as positive benefits (Baath, 1982; Kwiatek, 1982; Lister, 1988).

Twenty years later the technologies for interactive distance learning are much advanced yet little used. In our pilot NTU courses we employed a number of cutting edge technologies to enrich the satellite component of the course and to emulate studio at a distance (Fig. 1).

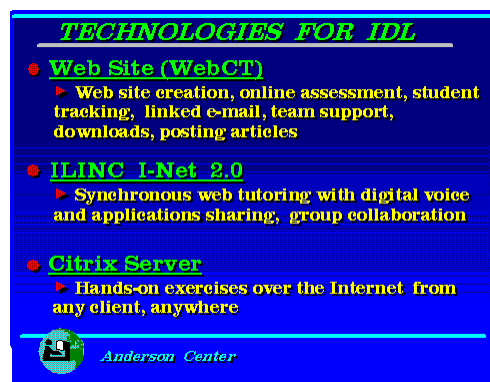


Fig. 1. Technologies utilized to add interaction to the NTU short courses *Hands-On Multimedia* and *Hands-On World Wide Web*.

The foundation of each course was a web site (Fig. 2) where students could access basic course information (syllabus, schedules, additional text materials etc.), the PowerPoint slides shown in the satellite broadcasts, the hands-on exercises, and links to various web-based resources such as electronic journals and web sites with materials on multimedia authoring or web site design. Following the satellite broadcasts, students could log onto the course web site and download the student manual of hands-on exercises for creating multimedia programs in ToolBook or creating web sites with HTML and a variety of software tools. For the first pilot course we used Microsoft Personal Web Server. To deal with the volume of traffic generated by the 8000 students enrolled in the second course, we installed Microsoft Internet Information Server on a dual processor Pentium Pro 200. This machine easily handled the several hundred hits per hour that the course web site received during peak access periods.

While we used HTML to create the web sites for *Hands-On Multimedia* and *Hands-On World Wide Web*, our current interactive distance learning model utilizes WebCT, a course web site creation and management package from the University of British Columbia. WebCT capabilities include point and click creation of web pages without HTML programming and a number of tools that facilitate learning and interaction for both on and off campus learners. Especially useful are a bulletin board for shared e-mail and course messages, and online testing and assessment.



Fig. 2. Home page for the *Hands-On Multimedia* course web site.

To do their hands-on exercises, course participants logged onto a Citrix Winframe server. The Citrix server allows thin client access to any program that will run under Windows NT server. Citrix clients are available for Windows, MacIntosh and UNIX machines. A detailed Student Guide to Installing and Running Course Related Software was available on the course web site. After installing the Citrix client on their computer, students could log onto the Citrix server over the Internet, run Asymetrix ToolBook II and other software, and conduct their hands-on exercises.

The Citrix server works by compressing screens of graphical information and sending that information over the Internet to the student computer where the Citrix client decompresses the screen and presents it to the user. It appears to the user that he or she is actually running the software on their own machine. (Fig. 3).

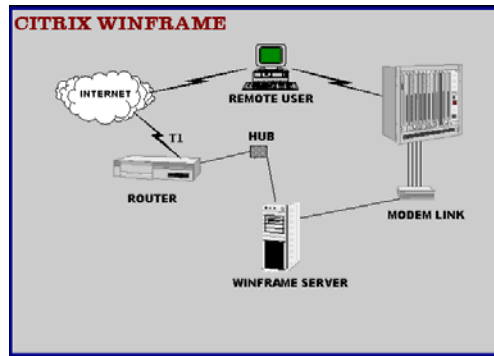


Fig. 3. Citrix Winframe server access from remote client on the Internet. Client software exists for Windows, MacIntosh and UNIX platforms.

After course participants had completed their exercises, they signed up for live, interactive, web-based tutoring session with the course instructors. These sessions were conducted with I-Net 2.0, software for web-based instruction produced and marketed by ILINC, a software company located in Troy, New York. Once again, detailed instructions were provided on how to download and install the I-Net client. When the client was up and running, students could log onto the RPI I-Net server over the Internet and join the tutoring session (Fig. 4).

I-Net is optimized for creating an interactive learning space on the web, with tools for virtual hand raising, question and answer sessions, and screen and applications sharing (Fig. 5). Interaction amongst session participants is facilitated by digital audio. The instructor has full control of the shared screen space, but can give control of the screen to any of the students logged into the session at any time. Other products from ILINC include the ability to transmit video via packet multicasting, but this capability was not utilized in either of our courses.

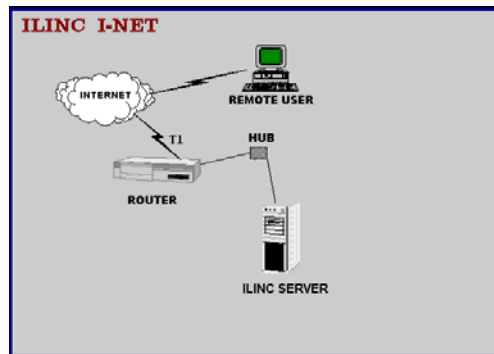


Fig. 4. Internet access to the ILINC I-Net server used for the synchronous tutoring sessions.

Another I-Net capability that we put to good use was synchronized web browsing. The I-Net software includes a synch agent that allows the course instructor to launch software such as web browsers on all the student machines and then control that software remotely. We used this feature during the tutoring sessions to go over new material with PowerPoint presentations that were stored on the course web sites. We also brought the students to several exemplary web sites related to multimedia and web site creation

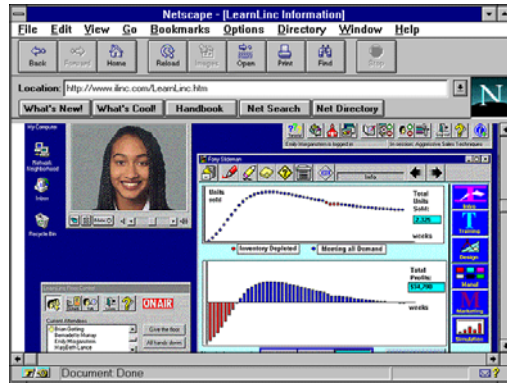


Fig. 5. A screen capture from an interactive ILINC tutoring session. The video capability is optional. The NTU courses utilized all of the available tools such screen sharing, question and answer, synchronized web browsing and applications sharing.

## ***Lessons Learned and Future Directions***

While not without a few inevitable glitches, the software tools that we employed to create our virtual studio classrooms worked extremely well. One of the roles of the Anderson Center is to serve as an incubator for new teaching methods and technologies. If our tests and pilots suggest that a new technology is stable, robust, cost effective and easy for faculty to use, we help integrate that technology into both the on-campus and distance learning curricula. Following our NTU courses, we feel that all of the software tools are ready for a production mode.

Supporting 8000 remote students was a challenge. Any time students have to download and install software on their machines, a Pandora's box of potential problems is opened. Student support was greatly facilitated, and many problems avoided, by creating student manuals and instructions that were exceptionally clear and straightforward. We supported both courses asynchronously via e-mail and the question arises as to how we can make e-mail support much more efficient and less time consuming, especially for large enrollment courses. We are currently experimenting with voice recognition programs that interface with our e-mail package.

I-Net 2.0 has fairly demanding hardware requirements: a 166 MHz Pentium with 32 MB of RAM and 100 MB of available hard disk space. This requirement prevented many students from participating in the online tutoring sessions. The wide range of audio boards and audio drivers also caused some problems with the I-Net digital voice program. But most students were able to successfully install the software, join the sessions, and interact with the instructors and the other students. Like an on-campus classroom, web interaction starts to break down with more than 40-50 participants and with large courses this obviously creates scaling problems if the interactive model is utilized. Finally, a challenge for future courses will lie in promoting team-based learning and group interaction outside of the tutoring sessions.

In the near future, current technologies for interactive distance learning will seem primitive. Increased bandwidth will open up new possibilities for sharing information, group interaction, and teaching at a distance. But for now, available

tools can greatly enrich traditional distance education and offer the off-campus learner many of the advantages of the on-campus studio classroom.

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