DEOSNEWS Vol. 8 No. 2, ISSN 1062-9416. Copyright 1998

EDITORIAL

We occasionally publish reviews from recent issues of _The American Journal of Distance Education_ which may be of interest to DEOSNEWS subscribers. One special feature that appears periodically in AJDE is the Media Review. This issue of DEOSNEWS includes an article from the media review section titled "Classroom Design for Video Teleconferencing," by Rick Shearer. As former Director of Research and Instructional Systems at National University in San Diego, California, Shearer writes from years of experience in distance education. Describing a broadcast model and an instructor-control model, this article presents basic information that can guide practitioners involved in the design and evaluation of video teleconferencing facilities.

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CLASSROOM DESIGN FOR VIDEO TELECONFERENCING

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Over the past four years we have designed and built a number of distance education classrooms at National University. While the basic design has been similar, each time we find ourselves reevaluating earlier decisions in the light of present needs. Because this issue is a recurring one for distance education practitioners, discussing design decisions may prove useful to others faced with designing a room for video teleconferencing.

First and foremost, we must decide how the room will be used. Will it be used primarily as a teaching site, a receiving location, or a combination of both? Also, will the facility be used by other members of the institution for other purposes?

If the room is primarily a teaching site from which instructors will be facilitating a course, then the first decision involves control of the equipment. This single decision, more than any other, will guide the overall design. This question is a difficult one, and not everyone will be pleased with the decision. Instructors who see themselves as technologically "savvy" will want control over the cameras and shot sequence; others will be very thankful if they do not have to worry about the technology and can rely on a technician to take charge. In many cases, the answer to this question is based on the institution's structure. Does the institution offer courses on a semester system, a quarter system, or, as in the case of National University, on a monthly basis? The answer will influence the schedules of faculty who need to be oriented to the distance education room in terms of course preparation and comfort with the equipment. Those fortunate enough to be able to spend four months or more with faculty members preparing them to teach through video teleconferencing will likely succeed in teaching instructors to manipulate cameras, audio, and images in a way that does not detract from the learning process. Those without this luxury of time may want to consider designing the teaching location based on a more traditional broadcast model, where technicians control the cameras, audio

levels, video feeds, and character generation, thus allowing the instructor to focus on facilitating the learning process. This latter model also provides some latitude in terms of the sophistication of equipment installed.

For simplicity this discussion assumes that the location to be designed is primarily a teaching site. This assumption will allow us to look at further design issues related to the two models outlined above.

THE BROADCAST MODEL

This model has both benefits and drawbacks for designing an institutional facility. The broadcast model allows use of a smaller classroom as a studio for the instructor and students, but also requires an adjacent room, somewhat larger than a closet, for use as the control room. At National, typical dimensions for our teaching classrooms/studios, which seat up to thirty students, are thirty feet by thirty feet. Locating equipment in the classrooms so that it can be controlled by the instructor would require a larger room; in the broadcast model, however, most of the equipment is located in the control room.

Equipment required in a typical classroom/studio based on the broadcast model includes, but is not limited to, cameras, microphones, an instructor's station, and monitors. Design considerations for each of these components is discussed below.

* Cameras. Three cameras are needed: an instructor camera, a student camera, and a document or overhead camera for slides and still images. The instructor and student cameras should be three-chip CCD types that provide a high-quality video signal. This consideration is important since even the best CODECs will degrade the signal as they digitize and compress it prior to transmission over the telephone lines. A single-chip CCD camera is adequate for the document camera since the signal degradation will not be as severe when still images are run through the CODEC.

* Microphones. Also needed is a series of push-to-talk microphones, at least one for every two students. In our design we have experimented with a variety of microphones and microphone placement options, from ceiling-mounted microphones to single microphones used by one or two students. While the ceiling-mounted microphones were aesthetically more pleasing, they did not work well, particularly in filtering ambient room noise. The signal to noise ratio was so high that student input could not successfully compete with noise from the air conditioning system, low-level student conversation, even the occasional crunching of Dorito chips! Ceiling-mounted microphones also are subject to building code restrictions.

We have also experimented with table-mounted open microphones, but these had similar problems with ambient room noise. Another major problem with open gated microphones was related to the echo cancellation software/hardware of the video teleconferencing systems. It appeared that the systems had been specifically designed to work with only one or two cardioid microphones; when trying to adjust the room to a series of open microphones the feedback algorithm did not work. These problems are currently being addressed with the use of push-to-talk microphones, which eliminate the need to constantly adjust the gain to account for room noise and have overcome the difficulties experienced with the echo cancellation systems.

* Instructor's Station. The instructor's station should be supported by a variety of equipment: computers for display of digital presentations or access to the Internet, wireless microphones, pointing devices, a monitor which displays the signal being transmitted, a scan converter for the computer, and, possibly a display station for use with an answer response system similar to OneTouch.

* Monitors. In addition to the monitor on the instructor's station, two larger monitors, no less than 35 inches in diameter, should be installed. One monitor should be mounted at the front of the room in line with the student camera and the other at the rear of the room in line with the instructor camera. The audio from the remote site may be played through either the monitors or a separate sound system. Our experiments with a variety of monitors and television receivers indicate that adequate viewing of text on the screen and presentations made from the remote locations necessitates 1) a screen size of at least 35 inches, and 2) mounting/support of these monitors that will allow for a clear line of sight from anywhere in the classroom.

The specifications outlined above are minimum requirements for the design of a videoconferencing classroom. The importance of good audio cannot be over-emphasized. Nothing will destroy the reputation of the system faster than poor audio quality. Students seem willing to adjust to the less-than-optimal quality of thirty frames/second video transmission, but will complain adamantly about poor audio quality.

The broadcast model offers a great deal of flexibility in terms of the type and quality of equipment installed in the control room. The trained technicians running each class are able to control a wide range of technology. There are, however, a series of decisions that need to be made prior to the final design. A few of these decisions deal with the issue of camera controls and video recording of class sessions. There are two options for camera controls: either the technicians will control the cameras through a remote pan and tilt system or equipment similar to CameraMan, which has an infrared tracking system to automatically track the person wearing the transmitter, can be installed. We have experimented with both and have come to rely on the remote pan and tilt systems, which give the technician ultimate control over the shots.

If class sessions are to be video recorded, a high-end edit deck in the control room will facilitate the process. These decks are designed for long hours of use and will hold up much better than less expensive consumer models or commercial playback/record decks.

Following are what we have found to be the minimum video equipment requirements for the control room:

* Pan and tilt control system for the operation of the cameras in the classroom

* A series of black and white preview monitors: one for each camera, one for the remote site, and one for the signal being sent to the record deck

* Two commercial SVHS play decks and one commercial SVHS record deck

* Preview monitors for each VCR deck and the record deck

* A character generator for text and a color preview monitor

* One waveform and vector scope to allow for color correction on classroom cameras

* One 13 inch or 15 inch program monitor which displays the signal which is being broadcast

* A video switcher that allows switching of video feeds and application of a variety of special effects

Audio equipment requirements include the following:

* An audio sound mixer, microphone mixers, and amplifier

* Speakers that allow monitoring of the outgoing signal

* Headphones that will allow the technician to hear the signal without ambient sound from the room noise

* Cassette deck and CD player for music

Other equipment which is desirable, but not essential, includes laserdisc players, computers with NTSC boards installed, and testing equipment.

Of course the key to these systems is the video CODEC, multiplexes, and audio cancellation boards that facilitate the change of the analog to digital signals that can be transmitted over regular telephone lines. These systems sit behind the control equipment with output video and audio feeds from the audio mixer and video switcher feeding into the CODEC.

The physical design of the control room is a matter of personal choice and often depends on the configuration of the room. A window equipped with one-way glass will allow the technician to make quick visual reference checks of the room in case of technical problems.

INSTRUCTOR-CONTROLLED MODEL

The main difference between the instructor-control model and the broadcast model is the absence of a control room. The classroom design in this model is similar to that in the broadcast model; however, additional monitors, a small video signal selector, and a small-group video teleconferencing system are additional equipment requirements.

The presence of the small-group video teleconferencing system in the classroom triggers the most critical design decision, that of placement of cameras and monitors. Those who have seen these systems in operation know that they have two basic configurations: single monitor and dual monitor. The main camera for the systems is a compact one-chip CCD camera with a built-in pan and tilt that sits on top of one of the monitors located on a cart. In most cases, the small-group system should face the students so that they can see the remote site(s), any information that the instructor puts on the document camera, and other video signals being displayed. A second camera on a pan and tilt will be controlled by the instructor from the instructor's station. Additionally, a large monitor will need to be mounted in line with the instructor's camera to enable viewing of the remote site(s) as they are presenting.

The instructor's station is another major consideration in the room design. The instructor will be

controlling the audio levels and video signals that go to the remote sites and to the local monitor in the on-site classroom; cueing up videotapes, audiotapes, and CDs, and controlling the cameras. As a result, the instructor's station needs to be modified or purchased with these functions in mind. Several companies now provide a touch-screen interface that will interact with the CODEC and the auxiliary video and audio components to provide the instructor with an intuitive means by which he or she can control the equipment. Integrating one of these systems into the design is highly recommended. Also necessary are SVHS record and play decks, as well as audiocassette and CD players. These items, which are all situated in the control room in the broadcast model, must now become part of the instructor's station or be controlled from the instructor's station. The configuration of the microphones should remain the same as in the broadcast model and should be fed into gated microphone mixers prior to being fed into a soundboard. This configuration offers maximum control over the audio characteristics of the room.

There is no one right way to design a room for instruction via two-way video/audio teleconferencing. Cost, the instructional environment, the institution's course structure, and the availability of instructors for training are critical considerations in design decisions. Contact with others who are practitioners in the field can provide valuable insights into what has worked and not worked with their room designs. Each generation of small-group systems brings with it innovations that may address previous obstacles, and those who have experimented with recent installations are often the best resources for designing a video teleconferencing classroom.

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Top of Page