The Chalkboard-less Classroom

Douglas C. Needham

SUMMARY. Classrooms are radically changing across United States campuses. Rooms that were once dominated by bright lights, chalkboards, and overhead projectors, are being transformed into multimedia “master classrooms,” complete with task lighting, video projectors, visualizers, laserdisc and videotape players, soft boards, and computers. What are these pieces of equipment, how much do they cost, and how can they be implemented into a horticultural curriculum? Computer hardware and software empowers today’s educator with a multimedia development studio on his or her desktop to create simple slide presentations or complex, interactive multimedia applications. However, it is not multimedia itself, any more than it was the chalkboard, that makes a powerful, educational presentation, rather it is the educator’s creativity, use of instructional methods, and delivery.

How can I teach without a chalkboard?! Multimedia. Classroom technology, which was once the chalkboard and discrete devices for presenting filmstrips, movies with sound, photographs, charts, and overhead transparencies, has developed into an interactive computer-controlled teaching lectern of various black boxes of audio, video, and data equipment. Interactive multimedia development software allows the educator to address different styles and paces of learning as he or she develops a lesson. Through on-screen hot spots, movable objects, and buttons, the educator engages the learner’s attention and provides the opportunity for the learner to rehearse a concept as often and repeatedly as necessary to encode the information for later retrieval and application to new concepts. Given the power of this new medium to present information visually and audibly, how does the educator avoid overloading the learner? Although multimedia applications readily engage the learner, it takes careful programming by the educator to maintain and direct the learner’s attention to ensure transfer of the information from short- to long-term memory.

For a presentation to be considered multimedia 1) there must be a computer to coordinate what is seen and heard and with which to interact; 2) there must be links that connect the information; 3) there must be navigational tools; and 4) there must be ways for one to gather, process, and communicate his or her own information and ideas (Hofstetter, 1995).

Hofstetter (1995) wrote, “If one of these components is missing, you do not have multimedia. For example, if you have no computer to provide interactivity, you have mixed media, not multimedia. If there are no navigational tools to let you decide the course of action, you have a movie, not multimedia. If you cannot create and contribute your own ideas, you have a television, not multimedia.”

¹Department of Horticulture and Landscape Architecture, Oklahoma State University, 360 Ag Hall, Stillwater, OK 74078-6027.

Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by Oklahoma State University is implied. Models specified may have been supplanted since the time this paper was presented. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

Oklahoma State Univ. (OSU) recently refurbished three classic lecture halls (rooms with tiered seating for 60 to >200 students) in Agricultural Hall to serve as models for university-wide multimedia "master classrooms," a term coined by Kathryn L. Conway and the Classroom Technologies Service Center at the Univ. of North Carolina at Chapel Hill in 1987. A subcommittee of OSU's College of Agricultural Sciences and Natural Resource's Committee on Effective Instruction, comprised of Wesley Holley, assistant dean of resident instruction; William G. Weeks, associate professor of agricultural education; and myself, in cooperation with OSU's Audio Visual Center, OSU's Physical Plant Services, and Consolidated Media Systems, Inc., of Branson, Mo., was challenged to 1) develop a budget and proposal for a model multimedia master classroom, 2) develop a budget and proposal for a multimedia authoring studio, 3) implement the proposed master classroom renovations, and 4) assist others with development of multimedia presentations.

Equipping a master classroom

The classic lecture hall, represented by tiered, arced seating, chalkboard, projection screen, overhead transparency projector, and lectern pit, exists across United States campuses and has undergone little technological change over the past several decades. The original design is still supported; however, several key technological improvements have been incorporated into the master classroom, including support for physically impaired persons. Two key issues were addressed for equipping the master classroom for multimedia presen-

tations: 1) meeting the needs of the educator and 2) meeting the needs of the learner.

MEETING THE NEEDS OF THE EDUCATOR. It was considered essential that an educator, whether from our college, from another college across campus, or from outside the university, find identical control systems and equipment in any master classroom on campus and that use of the equipment require minimal to no setup time since these rooms are typically in use every hour from 7:30 AM to 5:30 PM daily with only 10 min between classes. Therefore the master classroom has become standardized across OSU's campus with the equipment listed in Table 1.

An LCD video-data projector was selected for its ease of use and infrequent need of adjustment or maintenance. The projector is mounted to the ceiling and produces a brilliant image, even with all classroom lights on, with nearly imperceptible keystone effect. Since the projector uses three thin-film transistor (TFT) active matrix LCD panels, motion video moves smoothly. It should be noted that color bit depth of computer data is a function of the computer's video random access memory (VRAM), and projection of horticultural graphics with subtle color gradations requires VRAM that supports 16- or 24-bit color, i.e., thousands or millions of colors, respectively.

OSU's faculty use Macintosh and PC platforms; thus, the teaching lectern is built as an 89 × 25.5-inch desk with two knee holes—one for the PC keyboard and one for the Macintosh keyboard. The computers are mounted in the center pedestal of the lectern behind a lockable door. A lockable storage drawer in the center pedestal houses a remote pointing device (wireless

Table 1. Budget for master classroom.

Description	Price*
Sharp XG-E850U LCD video-data projector (Sharp Electronics Corp., Mahwah, N.J.)	6,000
Windows PC desktop computer	2,500
Power Macintosh 7600/132 desktop computer (Apple Computer, Inc., Cupertino, Calif.)	2,700
Panasonic WE-160 video imager (Panasonic Corp., N.Y.)	2,900
Sony GVM-1311Q 13-inch multiscan monitor (Sony Corp. of America, Teaneck, N.J.)	1,000
Sharp XA-505 VCR (Sharp Electronics Corp., Mahwah, N.J.)	300
Pioneer LD-V8000 LaserDisc player (Pioneer Communications of America, Inc., Rosemont, Ill.)	2,100
Elmo Omnigraphic 301AF slide projector with long range lens (Elmo Co., Ltd., New Hyde Park, N.Y.)	400
SoftBoard (Microfield Graphics, Inc., Beaverton, Ore.)	2,500
GyroPoint PRO GP9300-A remote pointing device (Gyration, Inc., Saratoga, Calif.)	300
Stewart audio amplifier and ceiling-wall mounted speakers (Stewart Electronics, Rancho Cordova, Calif.)	1,000
Shure SC1-CD wireless microphone with recessed ceiling speakers (Shure Brothers, Inc., Evanston, Ill.)	900
Bogen Goldseal GS-100 microphone amplifier (Bogen Communications, Ramsey, N.J.)	400
Williams Sound WIR-TX1, WIR-MOD1, RPK-003 hearing assistance device with three WIR-RX3/EAR-013 infrared receivers with earphones (Williams Sound Corp., Eden Prairie, Minn.)	1,500
Da-Lite Tensioned Cosmopolitan Electro-Video motorized projection screen (Da-Lite, Warsaw, Ind.)	1,400
Teaching lectern	1,500
AMX control system (AMX Remote Control Systems, Dallas, Texas)	10,000
Extron System 8, 202xi interface, and ADA-2 RGB video distribution amplifier (Extron Electronics, Anaheim, Calif.)	4,300
Videotek VDA-16 NTSC distribution amplifier (Videotek, Pottstown, Pa.)	400
Installation labor	12,700
Total	54,800

*Rounded to nearest \$100.

mouse), the AMX control system's touch panel, and infrared remote control. All equipment, including lights, projection screen, speakers, slide projector, and video-data input devices can be controlled from the AMX control system's touch panel (Fig. 1). Many of the functions are duplicated on the infrared remote to facilitate the educator's use of the equipment while moving about the classroom. The educator may also connect his or her own computer to the master classroom's equipment through the ethernet, VGA, and audio ports in the teaching lectern. Configuration of the desktop computers is maintained remotely by OSU's Computer and Information Services to avoid having configurations performed by one educator that inconvenience another. Educators may access their presentations from either of the desktop computers by logging into servers that store their files, by logging into their own desktop computers, or by bringing their files on floppy disks.

Alternate input devices include a VCR, laserdisc player, and visualizer. The visualizer is a modern version of a combined opaque and overhead transparency projector. It is essentially a color video camera mounted to a lighted stand, giving the educator the advantage of showing all members of the audience an object or transparency simultaneously. The visualizer's video camera supplies the signal to the AMX control system, which then routes the signal to the LCD projector on demand. The educator may zoom in or out to show details or an overall view, respectively. The visualizer works especially well for showing detailed features of plant structure, e.g., flower parts and leaf serration.

Behind the teaching lectern is a SoftBoard, a specialized white board that records the information written or drawn on it by the educator with special reflective-tipped, colored pens. Through a Windows PC or Macintosh computer the red, green, blue, or black images are stored and simultaneously transmitted to the AMX control system for routing to the LCD projector on demand. The

AMX control system's touch panel allows the educator to use selectively the piece of equipment best suited for supplying the video-data signal to assist with teaching the presented topic.

MEETING THE NEEDS OF THE LEARNER. Full use of multimedia presentations necessitates that changes be made in audio, video, and lighting fixtures. Typical classroom fluorescent lighting uses diffusion grilles to scatter the light for even illumination of the work surfaces, chalkboard, and walls. This often interferes with projected images, thus forcing the educator to darken the room for the audience to see the projected image. By changing the diffusion grilles to parabolic baffles that direct the light downward rather than scattering it, the work surfaces can remain lighted for ease of note taking, with minimal interference with the projected image. A motorized, video-data projection screen with tensioned cables not only ensures that the reflected image is brilliant for learners in the center and side wings of the classroom, but also that the image remains in focus even at the edges of the screen.

Since multimedia presentations rely on audio as well as video, amplification of computer, VCR, or laserdisc sound is important. Thus, wall or ceiling-mounted speakers were installed. Remodeling the larger of our three lecture halls—a >200-seat classroom—necessitated compliance with the Americans with Disabilities Act by installing a microphone and hearing assistance device. Infrared receiver earphones are available on loan to the hearing impaired from our associate dean's office near the master classrooms. Speaker volume, lighting, and the projection screen also are controlled by the educator from the AMX control system's touch panel (Fig. 1).

Equipping a multimedia authoring studio

Although the multimedia equipment in a master classroom provides the necessary technology, it is not the multimedia itself that makes a powerfully educational presentation, rather it is the educator's creativity, use of instructional methods, and delivery. "Everything we are used to—books, lectures, television—is one-way, focused on what the teacher, writer or actor does. It is hard for us to remember that it is not what the teacher does but what he or she gets students to do that results in learning," wrote Glick (1990). As educators we must grasp the technology of the time and meld it to meet our and our students' needs; however, many faculty members find that they have insufficient training or experience as graphic artists, computer programmers, or animators and too little time to create meaningful material without adequate training. Thus, some universities, e.g., Iowa State Univ., have faculty development specialists to assist faculty with conceptualizing, outlining, and developing interactive multimedia presentations. Without this kind of assistance,

Fig. 1. AMX control system's touch panel—main menu.

faculty must be provided the tools, education, and time to develop their lectures into multimedia presentations.

MEETING THE NEEDS OF THE EDUCATOR. OSU's College of Agricultural Sciences and Natural Resources converted two vacant offices into multimedia authoring studios, equipped with audio-visual Power Macintosh and Windows PC computers, slide scanner, flat bed scanner, CD writer, large monitor, computer video camera, color inkjet printer, and assorted multimedia and graphics software (Table 2). The studios are available first-come first-served or by reservation to all faculty and graduate students in the college.

MEETING THE NEEDS OF THE LEARNER. According to Gardner (1983), "...a human intellectual competence must entail a set of skills for problem solving—enabling the individual to resolve genuine problems or difficulties that he or she encounters and, when appropriate, to create an effective product—and must also entail the potential for finding or creating problems—thereby laying the groundwork for the acquisition of new knowledge." Gardner (1987) proposes that each of us possesses several different and independent capacities for solving problems and creating products, i.e., multiple intelligences. He groups the seven intelligences into three categories: 1) the language-related intelligences—verbal-linguistic and musical-rhythmic; 2) the personal forms—interpersonal and intrapersonal intelligences; and 3) the object-related intelligences—bodily-kineshetic, visual-spatial, and logical-mathematical intelligences. Thus, multimedia presentations should be tailored to address the multiple intelligences of the learners in the classroom, whether it is through personification of a concept, encouraging abstraction of a concept, or incorporating audio and video technologies in the classroom. Although multimedia applications readily engage the learner, it takes careful programming by the

educator to maintain and direct the learner's attention to ensure transfer of the information from short- to long-term memory. Master classrooms afford instructors full integration of audio, video, and data technologies through multimedia that not only promote multimodal learning but also permit students to return for supplemental instruction (SI) at their own convenience and pace.

Interactive, multimedia development software allows the educator to address different styles and paces of learning as he or she develops a lesson. Corporate America has realized the savings in time and labor associated with using multimedia computer-based training (CBT). According to Hall (1996), CBT results in an equal or higher quality of learning. Through on-screen hot spots, movable objects, and buttons, the educator engages the learner's attention and provides the opportunity for the learner to rehearse a concept as often and repeatedly as necessary to encode the information for later retrieval and application to new concepts. Given the power of these new media to present information visually and audibly, how does the educator avoid overloading the learner?

PLAN THE CONCEPT FOR MULTIMEDIA DELIVERY.

The complexity of the concept to be presented serves as the educator's guide to selecting appropriate software for development of the multimedia presentation. Highly complex concepts can be animated by authoring software, e.g., Macromedia Authorware, whereas less complex concepts can be presented by less dynamic slide presentation software, e.g., Microsoft PowerPoint. Appropriate selection of software will also reduce development time for the educator.

Regardless of the educator's choice of software, he or she should outline the objectives of the presentation and then detail the flow of information via a story board or time line that will be used to address each objective. The outline needs to

Table 2. Budget for multimedia authoring studio.

Description	Price ²
Two Windows PC desktop computers with 32 Mb RAM, 2 Mb VRAM, 1 Gb hard drive, CD-ROM drive, 16 bit sound with speakers and microphone, video capture card, ethernet card, SCSI adapter, and 17 inch multiscan monitor.	12,800
Power Macintosh 8500/120 AV Desktop computer with 32 Mb RAM, 4 Mb VRAM, 1 Gb hard drive, CD-ROM drive, and 17 inch multiscan monitor (Apple Computer, Inc.)	4,800
Windows PC laptop computer	6,900
Macintosh PowerBook 5300c laptop computer (Apple Computer, Inc.)	5,600
HP ScanJet 3c color flatbed scanner (Hewlett Packard, Corvallis, Ore.)	1,000
Nikon LS-3510AF slide scanner (Nikon Corp.)	4,500
HP DeskJet 1200C/PS color inkjet printer with JetDirect card (Hewlett Packard, Corvallis, Ore.)	1,800
Philips CDD522 compact disc recorder with software and cables (Philips Laser Magnetic Storage, Colorado Springs, Colo.)	2,500
PowerUser SyQuest 270 Mb removable cartridge hard drive (PowerUser, Lakewood, N.J.)	500
NEC MultiSync XM29 29 inch multiscan monitor (NEC Technologies, Wood Dale, Ill.)	2,800
FlexCam Pro color desktop camera (Videolabs, Minneapolis, Minn.)	300
Tables and equipment carts	700
Assorted software (Adobe Photoshop, Asymetrix Compel, Macromedia Authorware, and Microsoft Office)	7,500
Total	51,700

²Rounded to nearest \$100.

faculty must be provided the tools, education, and time to develop their lectures into multimedia presentations.

MEETING THE NEEDS OF THE EDUCATOR. OSU's College of Agricultural Sciences and Natural Resources converted two vacant offices into multimedia authoring studios, equipped with audio-visual Power Macintosh and Windows PC computers, slide scanner, flat bed scanner, CD writer, large monitor, computer video camera, color inkjet printer, and assorted multimedia and graphics software (Table 2). The studios are available first-come first-served or by reservation to all faculty and graduate students in the college.

MEETING THE NEEDS OF THE LEARNER. According to Gardner (1983), "...a human intellectual competence must entail a set of skills for problem solving—enabling the individual to resolve genuine problems or difficulties that he or she encounters and, when appropriate, to create an effective product—and must also entail the potential for finding or creating problems—thereby laying the groundwork for the acquisition of new knowledge." Gardner (1987) proposes that each of us possesses several different and independent capacities for solving problems and creating products, i.e., multiple intelligences. He groups the seven intelligences into three categories: 1) the language-related intelligences—verbal-linguistic and musical-rhythmic; 2) the personal forms—interpersonal and intrapersonal intelligences; and 3) the object-related intelligences—bodily-kineshetic, visual-spatial, and logical-mathematical intelligences. Thus, multimedia presentations should be tailored to address the multiple intelligences of the learners in the classroom, whether it is through personification of a concept, encouraging abstraction of a concept, or incorporating audio and video technologies in the classroom. Although multimedia applications readily engage the learner, it takes careful programming by the

educator to maintain and direct the learner's attention to ensure transfer of the information from short- to long-term memory. Master classrooms afford instructors full integration of audio, video, and data technologies through multimedia that not only promote multimodal learning but also permit students to return for supplemental instruction (SI) at their own convenience and pace.

Interactive, multimedia development software allows the educator to address different styles and paces of learning as he or she develops a lesson. Corporate America has realized the savings in time and labor associated with using multimedia computer-based training (CBT). According to Hall (1996), CBT results in an equal or higher quality of learning. Through on-screen hot spots, movable objects, and buttons, the educator engages the learner's attention and provides the opportunity for the learner to rehearse a concept as often and repeatedly as necessary to encode the information for later retrieval and application to new concepts. Given the power of these new media to present information visually and audibly, how does the educator avoid overloading the learner?

PLAN THE CONCEPT FOR MULTIMEDIA DELIVERY.

The complexity of the concept to be presented serves as the educator's guide to selecting appropriate software for development of the multimedia presentation. Highly complex concepts can be animated by authoring software, e.g., Macromedia Authorware, whereas less complex concepts can be presented by less dynamic slide presentation software, e.g., Microsoft PowerPoint. Appropriate selection of software will also reduce development time for the educator.

Regardless of the educator's choice of software, he or she should outline the objectives of the presentation and then detail the flow of information via a story board or time line that will be used to address each objective. The outline needs to

Table 2. Budget for multimedia authoring studio.

Description	Price ²
Two Windows PC desktop computers with 32 Mb RAM, 2 Mb VRAM, 1 Gb hard drive, CD-ROM drive, 16 bit sound with speakers and microphone, video capture card, ethernet card, SCSI adapter, and 17 inch multiscan monitor.	12,800
Power Macintosh 8500/120 AV Desktop computer with 32 Mb RAM, 4 Mb VRAM, 1 Gb hard drive, CD-ROM drive, and 17 inch multiscan monitor (Apple Computer, Inc.)	4,800
Windows PC laptop computer	6,900
Macintosh PowerBook 5300c laptop computer (Apple Computer, Inc.)	5,600
HP ScanJet 3c color flatbed scanner (Hewlett Packard, Corvallis, Ore.)	1,000
Nikon LS-3510AF slide scanner (Nikon Corp.)	4,500
HP DeskJet 1200C/PS color inkjet printer with JetDirect card (Hewlett Packard, Corvallis, Ore.)	1,800
Philips CDD522 compact disc recorder with software and cables (Philips Laser Magnetic Storage, Colorado Springs, Colo.)	2,500
PowerUser SyQuest 270 Mb removable cartridge hard drive (PowerUser, Lakewood, N.J.)	500
NEC MultiSync XM29 29 inch multiscan monitor (NEC Technologies, Wood Dale, Ill.)	2,800
FlexCam Pro color desktop camera (Videolabs, Minneapolis, Minn.)	300
Tables and equipment carts	700
Assorted software (Adobe Photoshop, Asymetrix Compel, Macromedia Authorware, and Microsoft Office)	7,500
Total	51,700

²Rounded to nearest \$100.

address navigation within the presentation—going back for review, skipping forward over understood concepts, or jumping to definitions of new terminology. Authoring software will allow the educator to incorporate not only navigation buttons, but also animation and assessable questions to help the learner visualize and evaluate his or her understanding of the concept, respectively.

STRUCTURE THE PRESENTATION. Keep cognitive load manageable by balancing text, graphics, and audio-video for maximum comprehension. Too many high-resolution graphics or digitized audio-video clips can dramatically increase the size of the presentation's file, too. Compression, e.g., JPEG, by a photograph manipulation software such as Adobe Photoshop will help ensure quick screen redraws and keep file size reasonably small.

Multimedia classroom presentations carry the risk of presenting too much information over too little time. If the learner is feverishly taking notes rather than trying to understand the concept, he or she will quickly become overloaded and lost. The educator should monitor the speed of the presentation and provide memory support. Clark (1989) advocates the use of on-line help or other means to provide memory support to the learner. I provide handouts that highlight the information to be presented, and thus not only serve as a visual framework to assist the learner with organization of his or her thoughts, but also relieve the learner's pressure to capture completely the presentation in notebook form. I find that these fill-in-the-blank outlines of my presentations help maintain the pace of presentation and yet allow my students to conceptualize the information and formulate their own questions, which leads to greater understanding and long-term storage.

PROVIDE FOR COMMAND PERFORMANCE THROUGH SI. By supplying the presentation to the World Wide Web (WWW), local area network, or individual computers, the educator permits the learner to return to the presentation at his or her convenience to review or to gain a greater understanding. Macromedia Authorware and Director presentations can be used over the WWW with a Shockwave-enabled web browser.

Conclusion

The three master classrooms in OSU's Agricultural Hall served as models for eight additional master classrooms that are available or in the process of being installed. Ag Hall's master classrooms are used nearly every hour from 7:30 AM to 5:30 PM daily for multimedia-based instruction in a variety of courses, including agriculture, agricul-

tural communications, agricultural economics, agricultural education, aviation sciences, biological sciences, family relations and child development, horticulture, human environmental sciences, management, math, political science, statistics, and others with relatively easy transition from one educator's setup to the subsequent educator's setup.

Student response to my use of the master classrooms for principles of horticulture science and basic floral design has been mostly favorable. As expected, some comment that I move through the presentation too quickly, others comment that I move through the presentation too slowly, and yet most find the speed of the presentation to be just right, i.e., the Goldilocks syndrome. Students praise the presentation outlines for just the reasons for which they were designed—organizing information, limiting note taking, and leaving more time to learn. More learning occurs when students are actively thinking and developing questions about the concept that is being presented than when they are acting as recording secretaries.

The master classrooms are serving us well; however, there is always room for improvement. Although integration of all the equipment's output by the AMX control system ensures smooth and reliable operation of the components, it is hampered slightly by differences in synchronization. A device to convert all video signals to one type before routing to the AMX control system is being investigated. Programming the AMX control system's software to perform automatic shutdown of the connected devices is also being considered. As multimedia technology changes and as faculty's creative use of the technology demands, the master classroom will continue to evolve as the chalkboard-less classroom.

Literature cited

- Clark, R.C. 1989. Developing technical training: A structured approach for the development of classroom and computer-based instructional materials. Addison-Wesley, Reading, Mass.
- Gardner, H. 1983. Frames of mind: The theory of multiple intelligences. Basic Books, New York.
- Gardner, H. 1987. The theory of multiple intelligences. *Ann. Dyslexia* 37:19-35.
- Glick, M. 1990. Integrating computing into higher education: An administrator's view. *Educom Rev.* 25(2):35-38.
- Hall, B. 1996. Is multimedia worth the money? *Training Dev.* 50(2):77-78.
- Hofstetter, F.T. 1995. Multimedia literacy. McGraw-Hill, New York.