Using HortBase in Education

Roger Kjelgren¹ and Larry Rupp²

SUMMARY. Computer technology allows horticultural educators to convey information more flexibly and visually to a greater audience. However, accessing and making use of technological teaching tools is as much a hurdle as it is an opportunity. HortBase provides the framework for educators in horticulture to easily access and contribute to quality chunks of horticultural educational by computer. Engaging computer-based instruction such as HortBase in distance or on-campus teaching is a three-step process. First, before assembling the teaching material, the educator must decide on who the target audience is and what information to convey. Audiences on campus often have higher expectations of how they want to learn, being accustomed to face-to-face instruction and guidance, but may not have a clear idea of what they want to learn. Off-campus audiences may have lower expectations but generally are more focused on the information they want. Second, the educator then must decide on how much of the information to bring into digital form oneself and what to draw from elsewhere. Chunks of digitized information can be created by scanning existing images into the computer or created on computer with drawing programs. Once digitized, images can be manipulated to achieve a desired look. This is laborious, so much effort can be saved by taking created chunks from HortBase. Finally, choose a medium for dissemination. Course content can be presented with slide-show software that incorporates digitized slides, drawing, animations, and video footage with text. Lectures can then be output to videotape or broadcast via an analog network. Alternatively, the digitized information can be incorporated into interactive packages for CD-ROM or the World Wide Web.

Technological innovations have given rise to many electronic teaching tools that have enhanced horticultural learning. Slide projectors, overheads, and video cassette recorders (VCRs) have brought horticultural images accessible previously only with field trips to learners in and out of the classroom. Recent and rapid advances in computer technology have sprouted a further array of tools for creating more innovative ways to assist in horticultural instruction. A short list includes, but is not limited to, software image creation, manipulation, and use and increased accessibility to information and learning exercises on the World Wide Web (Web). Computer-assisted instruction (CAI), either through creation or dissemination of chunks of instruction, enhances learning three ways over the traditional classroom with blackboards, overheads, or even slide projectors and VCRs by

- Creating images to convey abstract or inaccessible concepts,
- Increasing access to knowledge for students constrained by time or place and for horticultural instructors wishing to organize information into a course, and
- Providing interactivity through exercises and discussion forums that can give rapid feedback to students on-campus and those constrained by time or place.

Horticultural courses using CAI can be enhanced with computers by seamless incorporation of pictures and drawings into lectures taught live or broadcast off campus. Students could also pursue, and have graded, assignments at their own convenience, or engage in a digital dialogue with the instructor or other students in the same course on or off campus.

Department of Plants, Soils, and Biometeorology, Utah State University, Logan UT 84322.

¹Associate professor.

²Professor.

CAI has several limitations. In particular, when teaching horticultural topics over some kind of network to off campus students, the dynamic energy exchange between student and teacher can be lost, and providing hands-on experience is logistically difficult. Loss of face and hands-on time can be compensated for somewhat with more effective illustration of concepts (Dede, 1991) or online interactive forums (Klein, 1994). A general problem with CAI is the large investment in time and money required to be productive. Hardware and software used to create instructional visuals are expensive, have steep learning curves, and are rapidly obsolete. A horticultural instructor enhancing a course with CAI must invest substantial resources to be successful; thus, benefits from enhanced learning quality or accessibility must offset these costs.

Computer technology itself provides a solution to high costs by sharing the creation and use of CAI over networks. HortBase is a framework for horticultural educators to create and access electronic chunks of instruction. Distributing the effort of creating these instructional chunks, peer reviewing, and then cataloging them for wide access minimizes the cost of production, avoids redundancy, and ensures quality and access.

Development, sharing, and use of chunks of CAI can occur at several levels, from individual images to interactively graded exercises, to complete lectures. Three factors should be weighed in terms of benefits versus investment costs if a horticulture instructor has the desire to enhance instruction with computer assistance:

- Who is the target audience and how much will it benefit from CAI;
- The effort involved in creating chunks of CAI; and
- How to disseminate chunks of CAI appropriately and effectively to the target audience.

The target audience

Determining that there is a target audience, or clientele, that can benefit from CAI drives the process. A graduate-level plant physiology course that relies on student-teacher interaction will not necessarily benefit from

injecting electronic chunks of instruction into the mix. Horticultural courses that emphasize fundamental concepts and practices, on the other hand, can use CAI. Many areas of horticulture lend themselves well to concise chunks of computer-based information, such as pictures of different aspects of nursery production, drawings that image the function of plant growth regulators, animation of water movement in porous media, or an interactive program that calculates irrigation schedules.

Instructional chunks of information can be incorporated into teaching at several levels. In the traditional classroom, pictures and drawings can be imbedded into handouts and transparencies for more fluid presentation of topics. With additional initial investment, images can be combined with video and animation to be shown with liquid crystal display (LCD) projectors.

Courses designed to reach students constrained by time or place can particularly benefit from chunks of computer instruction. However, reaching horticultural students located off campus while maintaining teaching quality in a horticultural course is difficult. Again, the face-to-face dynamic of the traditional classroom is lost, and providing hands-on experience is difficult. Computer-developed or enhanced visuals, such as animations or video footage of a horticultural activity, can partially compensate by giving a sense of connection and immediacy to the lecture material.

Placebound students constrained by lack of accessibility to learning seeking distance education, however, tend to have lower expectations than those on campus, as they have few other educational options. In 1992-93 we produced the course Landscape Management in the Interior West for broadcast over satellite. In 1992 it was broadcast live to four states from an electronic classroom, and in 1993 prerecorded video lectures were broadcast with live hosting to, again, four states. Students, most located off campus, received credit from their instate institution hosting the broadcast. To maximize the use of our time and effort, students enrolled in the course on the Utah State University (USU) campus also viewed lectures via television. Students followed the lecture with a course reader and communicated with the instructor during the broadcast via phone lines; assignments and exams were mailed to students. Students were surveyed at the end of the course regarding the quality of their learning experience.

We switched to prerecorded lectures in 1993 to reduce the difficulties associated with a live broadcast. Of 1993 students, one-third viewed the course on campus, mostly at USU, but also at the University of Wyoming and University of Idaho campuses. The rest were

Table 1. Student responses in 1993 to the question of how the Landscape Management course compared to others they had taken, where ratings are 1 = very unfavorably and 10 = very favorable (N = 54).

Location	Rating category									
	1	2	3	4	5	6	7	8	9	10
Percentage responding by category										
On campus	11	11	6	28	0	6	22	6	11	0
Off campus	8	6	8	8	8	17	11	19	8	6

enrolled in off-campus programs, primarily in Utah. When surveyed as to how the course compared to others they had taken, off-campus responses were distributed rather normally, with a favorable median rating of 6 on a scale of 1–10 (Table 1). The distribution of on-campus responses, however, was bimodal, with a median value of 4. Comments accompanying the survey indicated that for those placebound students off campus, the lack of face-to-face contact was overlooked in favor of the advantage of just being able to get the information. Comments from on-campus students were favorable for those with scheduling or other time constraints, but more than half said the course did not compare well to others they had taken and that they preferred face-to-face instruction.

Production of the prerecorded lectures in 1993 required a great deal of time, about 4 hours for every hour of actual instruction. We extended the longevity of our production efforts by using the prerecorded lectures on campus. From 1994–96, Landscape Management in the Interior West was offered every term on an arranged basis where students viewed videotape lectures at their discretion, again following along with lecture notes in a course reader. Students were again surveyed at the end of each term as to their opinion of the course. Most liked the flexibility of viewing a course on videotape, as the median value was 4, on a 1–5 negative to positive scale (Table 2). The distribution was somewhat bimodal, so almost one-third of students did not like having to arrange their own time for learning. For many students, however, flexibility was a trade-off for a lower-quality learning experience, as opinion of the educational value of the course was less favorable, with a median value of 3.

The broader the distribution of CAI, for example, to on- and off-campus students taking the same course, the more cost-effective the initial production effort. A course developed for distance education off campus can be used on campus for students with time constraints. On-campus students with time demands from family or work that limit their ability to fit a fixed-time, once-a-year, course into their schedule benefited from one arranged at their convenience (Table 2).

The more that CAI, in the form of visuals and instructor accessibility, is incorporated into a course that is not taught live, the less educational quality is sacrificed. Such a course could also benefit the faculty member teaching the course by shifting time spent in the classroom to other activities, such as hands-on learning. We are upgrading the course Landscape Management in the Interior West by producing lectures on computer, then recording directly onto videotape. The course will be offered year-round on videotape to maximize schedul-

Table 2. Student opinion of the Landscape Management caourse on a scale of 1 to 5.

Opinion	Rating category				
	1	2	3	4	5
	Percentage responding by category				
Educational value	7	30	26	24	13
Flexibility of time management	19	9	8	19	45

ing flexibility for students and will be combined with an under-construction Web site containing syllabus, outline, interactive assignments, student discussion form, and outside links to relevant sites. For students desiring the dynamic of face-to-face student–teacher energy exchange, we will offer the course in a traditional classroom on alternate years. A separate laboratory course is offered such that students can get hands-on experience.

Creating instructional chunks

The success of a shared, accessible network of CAI such as HortBase will depend on an open exchange of instructional chunks between contributor and user, which may often be the same person. An instructor wishing to contribute to the network needs to decide how much to create oneself by investing money and time in software and enhanced hardware or by investing in an equipped computer-graphics specialist. However, even communicating with a graphics specialist requires a minimum level of computer knowledge.

Chunks of electronic instruction need visuals to be effective. The easiest way to incorporate visuals is digitizing individual existing pictures in a physical format with a scanner. Existing images such as snapshots or line drawings can be digitized with a flatbed scanner, while slides require a special scanner. Selecting an appropriate resolution while scanning an image is important. The higher the resolution, the better the image quality but the larger the file size. If storage space is limited, the better choice would be to determine the final size of the image as it will be used and scan at the minimum resolution that is acceptable. If disk storage is not limiting, the image can be scanned in at a higher resolution in case it is manipulated or retouched at a later date. Equally easy in getting a physical image into a computer is to use a digital camera. Digital cameras offer quick means of getting still images into a computer, but anything with less than 640 × 480 resolution with 24-bit color has barely satisfactory image quality.

Most images can be manipulated to enhance image quality, but such effort requires more investment in skill development. When brought into a bitmap editing program, such as Adobe Photoshop or Corel Photopaint, image size and resolution can be reduced. Reducing

Fig. 1. Original slide image scanned at 22 × 33 mm, 676 dpi, 1,600 kb file size. Image at left resized to 51 × 78 mm, 200 dpi and 734 kb, image on right kept at same size but 50 dpi resolution and 46 kb file size. Converted to compressed GIF format, file size for each image would be 313, 140, and 13, kb respectively.

resolution too far degrades image quality (Fig. 1). Images are typically scanned in uncompressed bitmap formats such as TIFF (tagged image file format) and BMP (Windows bitmap format), and in a bitmap editing program the image can be saved in compressed GIF (graphics interchange format) or JPG (joint photographic experts group) format. Most software supports object linking and embedding that allows importation of bitmap files into documents. Compressed format graphic files are maintained in new software, but are decompressed in older software, thus failing to realize file size savings with GIF and JPG images. Manipulating bitmap images in the computer can yield very useful teaching images. Specific components of an image can be extracted with masking tools then used to create a new, highlighted image (Fig. 2). Masking and cloning tools can be used to combine components of different images for a specific effect (Fig. 3).

Video from a VCR or camcorder can also be digitized with separate plug-in capture boards. These boards may be able to capture audio directly, or require use of a separate soundcard. Video capture is in motion-JPG format and is done manually without help from a time code on the video footage, so starting and ending points are determined manually. Most boards come bundled with video editing software so that a video clip can be edited to taste, and then the edited clip is converted to compressed format, either AVI (Windows video format) or MPG (motion picture experts group). There are several CODECs (compression-decompression algorithms) available for

AVI files that can generally be selected that trade off compression size for quality. Video converted to MPG format has higher quality and better compression. Both formats use key frames at selected intervals that record all the information in a picture and reduce file size by discarding any repeated information on adjacent frames. Capturing, compressing, and manipulating quality video and audio requires substantial training and disk storage space.

With a combination of computer and artistic skills, images can be drawn with vector software such as CorelDraw. Vector-drawing software creates images based on vector instructions versus setting the color of pixels in bitmaps, thus they can be easily resized without changing the file size (Fig. 4). Vector images can be easily converted to bitmaps, particularly GIFs for use in Web pages. Conversely, bitmap images can be converted to vector images with a tracing program, but complex bitmaps do not convert well. Sequential bitmap images that actively demonstrate a concept can be combined to create animated video in software such as Adobe Premiere or when converted to GIFs an animated GIFs can be created for the Web. Bitmap manipulation and vector drawing clearly require a high level of skill to create quality images.

Using chunks of electronic instruction

Chunks of CAI can be incorporated in teaching three general ways. The simplest is to take single images and incorporate them into text notes with a word processor. Current releases of major word-processing software

Fig. 2. Both images scaled to 200 dpi, 22 × 33 mm. Original image at left 135 kb; image at right masked then clipped has a file size of 107 kb.

support the adding or linking of graphics into word processor documents. The combined text and graphics document can be printed for student notes and on transparencies for use with overhead projectors in live lectures, and improvements in inkjet printers now allows affordable color printing. As most people are familiar with word-processing software, en-

hancing a lecture with simple visual resources developed oneself or drawn elsewhere is not difficult. Word processor file sizes, however, can become quite large and difficult to work with if graphics are imbedded.

Teaching on the Web is at the other end of the instructional spectrum and requires skill in computer graphics and programming in hypertext markup language (HTML). Presenting courses over the Web is at an incipient stage with many uncertainties yet to be worked out. Offering students hands-on experience is clearly outside the realm of Web pages, but

Fig. 3. Original landscape photo on left. Retouched photo on right where all the image except for the slope has been masked, then plants from a low water use landscape have been cloned in over the slope.

Fig. 4. Schematic representation of tree water loss drawn in CorelDraw.

presenting syllabi, outlines, and course content is just as clearly the strong point of a Web page. Posting straight text is quite easy with newer software that can save information in HTML format (e.g., HYPERLINK <http://www.biology.usu.edu/Bio523/gamete.html>), but such Web pages offer accessibility if little else. Appearance can be enhanced with presentation software converted to HTML (e.g., HYPERLINK <http://www.biology.usu.edu/hort/gamete/sld001.html>) and the addition of simple animations (e.g., HYPERLINK <http://psb.usu.edu/hort/pli/tuneup.html>). The full potential of instructional Web page is realized with interactivity. Online student discussion forums, either as live Internet relay chats or a bulletin board set gives students the ability to ask questions of each other and the instructor (e.g., HYPERLINK <http://www.zdu.com>). Interactive animations allows students to review concepts (e.g., HYPERLINK <http://wheat.usu.edu/courses/plsc2000/outline/meiosis/meiosisvid.html>) at their leisure. Other applications can be linked to a Web page with common gateway interface and java scripts to provide interactive calculations and other instructional modules that can very effectively convey complex concepts (e.g., HYPERLINK <http://vflylab.calstatela.edu/edesktop/VirtApps/VflyLab/IntroVflyLab.html>). The more sophisticated the interactivity, however, the more skill is needed to execute a successful Web page.

The third way of using CAI is with presentation software that can be mastered less effort than a authoring a Web page. Presentation programs such as Microsoft PowerPoint or Corel Presentation provide the framework for importing text and graphics, such as vector

drawings, bitmaps, and AVI or MPG video, that can be presented in a visually appealing manner. In developing a presentation, imported images and graphs can be timed to appear or disappear in different ways with animation settings and annotated with text or enhanced with drawing objects created with the presentation software. These programs come with stand-alone viewer software such that anyone can view the presentation if they have the viewer.

Instruction created with presentation software can be further disseminated several ways. They can be converted to HTML format and viewed as static images, or with animation when a special viewer is used, over the Web. Perhaps more commonly, instruction created with presentation software used in face-to-face teaching is output from a computer and shown with an LCD projector. Less commonly, the presentation can be output to videotape on a VCR with a scan converter. A scan converter takes the video signal from the computer and converts it to an analog signal that can be recorded with a VCR. The computer presentation can be combined with audio narration directly into the VCR to create a complete videotaped lecture that can be easily disseminated.

The electronic instructional possibilities offered by shared resources over a network, such as HortBase, and the evolution of computer technology does not mean a migration to a totally new medium as much as broadening existing horizons. The intangible student-teacher dynamic in traditional classrooms is the source of inspiration for turning people's view of themselves and the world around. It is doubtful that CAI will ever find a way to recreate that dynamic.

Use of electronic instruction in the realm of horticulture, combined with the resources such as HortBase, offers several ways to improve instruction:

- The means to enhance existing classroom teaching;
- Reaching students constrained by time and place with high-quality instruction;
- Providing a new dimension of teacher-student interaction by e-mail and discussion forums;
- Achieving these improvements requires time and money, the burden of which can be lessened by sharing development and using chunks of electronic instructional.

Information resources cited

- Dede, C. J. 1991. Emerging technologies: impacts on distance learning. *Annals, Amer. Acad. Pol. and Social Sci.*, 514: 146-158
- Klein, T. 1994. Information technology: teaching and learning in the twenty-first century. *College Teaching* 43:151-155.