ABSTRACT: There are many methods and techniques for delivering instruction through the Web. Academic and industrial courses can be enhanced with Web-based links, or the courses can be delivered completely via the Web. Instructional content can be delivered through e-mail “correspondence-type” courses, via Web pages written in HTML, or with very complex interactions developed with Java, JavaScript, Shockwave, ActiveX, or other tools. In this brief discussion, I will outline a range of Web-based instructional options, provide general guidelines for designing Web-delivered instruction, discuss two case studies, and include links to example Web-based training (WBT) sites.

Online Instruction

In the past, the primary technologies used to deliver instruction to remote students were two-way interactive video and one-way prerecorded video (Lewis, Alexander, & Farris, 1997). Although effective, these technologies have their limitations, including access, distribution, and interactivity. With the emergence of the World Wide Web, we now have a worldwide, efficient, and inexpensive mechanism for delivering instruction.

The delivery of instruction via the Internet and/or Web can include a range of options, such as e-mail correspondence, Web-enhanced instruction, Web-managed instruction, and Web-delivered instruction. It is important to note that these categories are somewhat arbitrary and are not exclusive. For example, a Web-managed course could easily include components of the Web-delivery and Web-enhanced classifications.

E-mail Correspondence Instruction

With e-mail correspondence courses (which have been around for many, many years), instructions and/or assignments are e-mailed back and forth between students and instructors. A course offered in this manner often includes an offline textbook or other instructional materials.
Web-enhanced Instruction

With Web-enhanced instruction, the instructor creates a Web page (or pages) with relevant links for the class. Web-enhanced instruction is generally designed as a supplement to on-campus/on-site instruction. (See http://www.coedu.usf.edu/inst_tech/resources/design.html for an example used in my instructional design course.)

Web-managed Instruction

With Web-managed instruction, a tool, such as ActiveX, TopClass, Learning Space, or Web Course in a Box is used to provide an architecture for course information and materials. These Web-management tools are not generally designed to create instruction; instead they provide an easy, effective means of managing (with password access and student tracking) course information and materials. Many of the tools also offer features related to student and faculty collaboration such as chat rooms, discussion groups, and e-mail.

Web-delivered Instruction

Web-delivered instruction (commonly referred to as Web-based Training or WBT) includes courseware in which the instruction, interactions, and feedback are delivered via the Web. This type of instruction can be created with many tools, such as HTML, Javascript, Java, Shockwave, or Neuron.

There are several Web sites that provide definitions of WBT and can serve as excellent supplements to this discussion. On the WBT Information Center (http://www.webbasedtraining.com), Tim Kirby defines WBT as "an innovative approach to distance learning in which computer-based training (CBT) is transformed by the technologies and methodologies of the World Wide Web, the Internet, and intranets." On the Multimedia and Internet Training site (http://www.multimediatraining.com), Brandon Hall provides a broader definition: "Web-based training is instruction that is delivered via a Web browser, such as Netscape Navigator, through the Internet or an intranet."

Other terms that have been used for this category of instruction include IBT (Internet-based Training), WBL (Web-based Learning), and WBI (Web-based Instruction). In the industrial arena, WBT appears to be emerging as the acronym of choice; the academic arenas seem to prefer WBI or WBL.

For the remainder of this paper, I will focus on WBT (as opposed to e-mail correspondence, Web-enhanced, or Web-managed instruction). I will use the term WBT to refer to interactive instruction that is delivered via the Web (in both academic and industrial environments). This instruction will be assumed to be "stand-alone"—in other words a "traditional" class does not meet, and the course content and feedback are included in the WBT program.

Design Options for WBT

A few years ago, when the Web emerged as a feasible option for the delivery of instruction, the
only development option was HTML. At that point, the Web consisted of scrolling pages, and the
design of those pages could be based on general Web style guidelines (see, for example, the Sun
of new HTML tags (such as framesets), authoring system plug-ins (such as Shockwave) and
programming languages (such as Java), there are several options for the design and development
of WBT. Web pages are no longer confined to scrolling pages; instead, the design may include
page-based, frame-based, and screen-based options.

Page-based WBT

Page-based WBT consists of scrollable HTML pages. In other words, a page-based program does
not have frames; a single scroll bar will appear if the document is long or the window is
decreased. Advantages of page-based WBT is that it is generally more accessible to a worldwide
audience (because it can be created in basic HTML). In addition, it does not generally require
any authoring system plug-ins, and most users are comfortable using the browser and embedded
links to navigate through the pages. Disadvantages include the need to scroll through the pages
(if they are long) and the lack of static menu options.

One of the first examples of page-based instruction was the Interactive Frog site that was
developed by the Curry School of Education (http://curry.edschool.Virginia.EDU/go/frog/). This
site consists of scrolling Web pages and interactions based on hyperlinks to another Web page. A
more current example of a page-based site is the Gartner Learning Demo at
http://www.gglearning.com. Although it includes embedded Shockwave files and Javascript, the
basic structure remains page-based.

Frame-based WBT

When the frameset tags were added to HTML, a new design/development option emerged. With
frames, one or more parts of the screen can remain static while the other part or parts change
and/or scroll. The advantages of frame-based WBT is that a menu or other options can remain on
the screen, in the same place at all times. Disadvantages of frame-based programs include the
fact that it is more difficult to print the information (only the active frame will print), and the
access time increases because multiple pages must be transmitted.

One of my favorite frame-based WBT sites is Anatomy of An Eye
(http://www.netscape.com/comprod/products/navigator/version_2.0/frames/eye/). The image
map on the left provides a consistent menu of options. A more comprehensive example of a
frame-based site is Digital Think (http://www.digitalthink.com). In this example, the left frame
is used for a menu of button options. The Cyber Travel Specialists site also uses frames--perhaps
too many (see http://cybertravelspecialist.com/).

Screen-based WBT

The advent of plug-ins, such as Shockwave for Authorware and Neuron for ToolBook, created
another design option for WBT. When courseware is produced using one of these tools, the
screen design can appear almost exactly the same as "traditional" CBT. (Note: A screen-based
look can also be created by hiding the browser menubars with Javascript.)
Advantages of screen-based programs include the fact that each screen can fill the display window; scroll bars are not included; existing courseware can be converted for Web delivery; and management systems are available (such as Librarian for ToolBook and Pathware for Authorware). A major disadvantage is that the students may be required to download and install a plug-in. In addition, the memory requirements may be high and the transfer time may be long.

Cruising the Information Superhighway is an example of a screen-based program that was created in Authorware, shocked, and placed on the Web (http://www.macromedia.com/learning/examples/online_examples/training/internettutorial/). Note that as soon as the program is accessed, it fills the screen (if you are in 640X480 resolution).

Design Considerations for WBT

Whether you are designing page-based, screen-based, or frame-based WBT, it is important to consider a few "rules of the road." Some of the following guidelines are derived from the wealth of literature on the design of computer-based training and multimedia instruction, and some of the guidelines are based on style recommendations for Web pages. The guidelines should be interpreted broadly, based on specific content, the intended audience, and the format of the data.

Conduct a Thorough Media Analysis

The media selection process should include the feasibility of delivering instruction via videotape, audiotape, lectures, CBT, WBT, and other media. Several factors that might point to using WBT for delivery of educational programs include:

- **Dynamic information that must be updated constantly.** With WBT, the course content is stored on a Web server that can be quickly updated, ensuring that all students will be accessing the latest version of the courseware.

- **Widely-dispersed audience.** If the target audience is widely dispersed, there is no other vehicle that can deliver courseware in such an efficient and effective manner as the Web.

- **Content that does not rely heavily on audio or video.** Although streaming technologies offer a lot of promise for the delivery of audio and video through the Internet; at this point, audio and video should be used sparingly in WBT.

- **Courses that would benefit from communications with the instructor.** With WBT, you can include options for students to communicate with the instructors through e-mail, chat, or other technologies.

Place Course Objectives First and Foremost

With easy-to-use HTML tools, such as FrontPage and Composer, Web pages can be created relatively quickly. To quote (roughly) David Merrill at a conference several years ago "authoring
Analyze the Platforms of the Target Audience

Every instructional designer understands the value of defining the characteristics of the target audience. With WBT, the audience analysis is vital because the users may be scattered throughout the world, and they may be using a wide variety of network, hardware, and software options. The speed of the network might range from dialup access via 28.8 modems to intranet access via a 100Mbps network. The hardware could include Macintosh, UNIX, and PC computers at various speeds and performance. Software considerations include the browser type and the plug-ins.

If you are designing WBT for a specific company, you (or the company) may be able to “dictate” a specific platform and browser; in which case, you can design accordingly. If you are designing for a worldwide audience, you must consider the lowest-common denominator of the target audience and provide information on your site to notify users about the recommended platform(s). For example, the Cyber Travel Specialist site at http://cybertravelspecialist.com/demo/lesson4.htm provides information about the recommended browsers and includes information for AOL users.

Make the Interactions Meaningful

With current WBT development tools, there is almost no limit to the level of interactivity that can be included. Whether you add some basic Javascript to HTML pages or create the courseware in Java or Shockwave, the interactions should require cognitive engagement on the part of the students. Simply adding a Next and Previous button on each page may require “physical” interactions, but they may not engage the student’s mind.

An example of well-designed interactions is available on the Sticky Situations site (http://www.iconos.com/stickyshock.html). This site, which was created in Authorware, requires the student to think about alternate solutions and test them out. It also provides supplemental instructional information on the site with well-designed graphics. The Radiologic Anatomy Interactive Quiz (that was developed with Java) is another example of an interactive site (http://www.gsm.com/resources/raquiz/).

Consider Visual Guidelines

When multimedia instruction is delivered on CD-ROM or other mass storage devices, the amount and size of graphics is not generally an issue. However, on the Internet, each picture must be transferred separately from the remote computer. The transfer time can vary based on the type of connection and the amount of traffic on the lines. Before incorporating a graphic, assess its pertinence to the overall message. The following guidelines are offered for graphic use:
• **Use high contrast between background and foreground.** There should always be a high contrast between the text and the background color or texture to ensure maximum readability. Also, remember that the students may have ultimate control over pages on the Web—in many cases, they can resize the window (perhaps causing the text to scroll), change the size of the text, and change the color of the text.

• **Limit the size of graphic files.** Graphic files should be kept as small as possible, with no one graphic being larger than 40K. This limit may mean that you use a banner rather than a full-screen graphic; that you limit the number of colors; or that you incorporate thumbnail pictures to let the user decide if it is worthwhile to display the whole image. The file size of graphics in the GIF format may be minimized by reducing the number of colors or the complexity of the image. JPEG graphics should be created at the maximum compression that still produces an acceptable image quality.

• **Limit the number of unique graphics on each page.** Each time a unique graphic is requested, the client computer must access the server. This access time is in addition to the transfer time required for each graphic. If possible, "recycle" graphics on a site. For example, navigation bars that are re-used can be accessed from cache rather than the server.

• **Limit the width of graphics to less than 472 pixels.** Most browsers default to about 500 horizontal pixels on Macintosh and Windows computers. If the instruction is designed for a worldwide audience (who may be using 640X480 resolution) limit all images to 472 pixels in width so the learners will not have to scroll.

**Differentiate Among the Hyperlinks**

Hyperlinks are major components of WBT, but incorporating them effectively can be a challenge. Questions arise, such as: "How will the student know if a hyperlink branches to a local glossary page or a distant resource?" "Is it important for the students to know where they are in cyberspace?" "If the students branch to another site, will they know how to return?" "Can designers, or should designers, insist that the students not wander to other Web sites?" Although there are no definitive answers to some of these questions, a few recommendations include:

• **Use descriptive words for links.** Try to use words other than click "here" as links in your documents. You may also want to include visual or textual clues to inform your students when they are leaving the site (so that they will understand that the interface may change). For example, the NASA site at http://wit.ksc.nasa.gov/agenda/html/agreements3.html includes an image of a set of binoculars and the text: "Explore Guidelines for Reimbursable Agreements. (offsite link)" as a clue to users that they will be leaving the NASA site.

• **Include fixed links to provide a structure to the WBT.** The BACK and FORWARD buttons on the top of the screen in browsers like Netscape may link to another site in another country, based completely on the user's previous path. If you provide a PREVIOUS PAGE, NEXT PAGE, and MAIN MENU in the body of the instructional pages, you will benefit the users by providing them the interface tools to navigate through the information at your site, in the sequence that you intended. See the Gartner Group Learning site for an example of fixed links (http://www.gglearning.com).
• Provide information for links that involve large file transfers. If the link involves a file transfer, provide information about the file size and the format that it is stored in. If plug-ins are required, links should also be provided for easy access and downloading.

Limit the Length of Web pages

If the program is designed with a screen-based approach, the length of each page is not an issue, and the amount of information on each page can be dictated by general CBT design guidelines. If the program is page-based, the question of page length arises. Even if you design each page to be one screen in length, the user may re-size the browser thereby creating a scroll bar.

Most Web designers agree that the initial page of a Web site or program should not exceed one page--all of the pertinent information should be immediately visible so that the user will not have to scroll down the page to find the options. On other sections of the course (past the initial page), a good limit seems to be one-to-three screens in length. A disadvantage of short pages is that if users want a printout, they must print several documents and "piece" them together. To address this issue, it is wise to provide a link to a separate file (with the entire text) that can be printed or saved as one document. For an example of a WBT program that offers alternate versions, based upon whether or not the students are interested in printing, see the SLAC--Environmental Safety, & Health Training at http://www.slac.stanford.edu/esh/training/study_guides/study_guides.html.

Minimize the use of Audio, Video, and Plug-Ins

Multimedia elements remain a challenge for WBT at this point. If you use non-streaming media files, they may take a long time to download. If the media files (generally in WAV, AVI, or QT formats) are important for the lessons, try to keep them as small as possible by using only pertinent segments, sampling at minimal rates, and compressing the files as much as possible. Also, be sure to inform the users about the file formats and warn them about the length of time it may take to download the files.

Streaming technologies (such as RealAudio and Shockwave Audio) offer a major advantage in that the files will play as they transfer. However, if you incorporate streaming technologies, the users may need to download and install plug-ins.

Because of the frustrations that plug-ins can cause, you should carefully consider all alternatives prior to using them. Not only are there many versions of plug-ins, but they are constantly updated, and can be tricky to install. The general suggestion is to use media elements only when they are essential to the instruction. (For an example of RealVideo used for training, visit Dterm Series III Online User Guide at http://userguide.ilibrary.com and click on "Teach Me.")

Encourage Collaboration

A major advantage of WBT (as opposed to CBT and other training options) is that it is relatively easy to incorporate (and encourage) communication between the instructor and the students. This communication can be asynchronous (e-mail, discussion groups, etc.) or synchronous (chat, videoconferencing, etc.). For an example of a WBT program that incorporates collaboration, visit
Case Study #1:
The Teacher's Guide to the Holocaust

The Teacher’s Guide to the Holocaust was produced at the University of South Florida over two years ago (http://fcit.coedu.usf.edu/holocaust). The target audience of this program is teachers throughout the world. Many teachers are using older versions of browsers because of memory and hardware constraints on older computers. Therefore, the program was designed to operate in Netscape 2.0, without plug-ins, Java, or Javascript.

The focus of the program is placed on the content and the design is quite simplistic. The production included the development of hundreds of HTML pages with over 350 gallery photos. Subsequent to its development on the Web, this site was also distributed to all schools in Florida on CD-ROM. Design elements that were considered in the development of this program include:

• The width of the all images is 472 pixels or less (they will display in a default browser).

• The links are on the Main Menu are on the left side of the page (in case a user re-sizes the browser window, the links will still be accessible).

• The links on the other pages are centered at both the top and the bottom of the page (the text links will wrap if the browser is re-sized).

• The size of the Main Menu is less than 30K (it was created with only eight colors). File sizes of all graphics were reduced for the Web.

• There are text links on all pages (in case someone is using a text browser).

• The code will work with either client-side or server-side image maps.

• The height and width attributes for all images are included in the HTML code so that the page will display quickly.

• A Site Map is included to enable users to easily navigate the program.

• Visual clues are included for hyperlinks to photographs, glossary, documents, external links, etc.

• The music is stored in MIDI format (which is much smaller than WAV or AIFF).

• Feedback from users is solicited via a form to submit Holocaust Activities and MAILTO links to the project manager.

• The 8.3 standard DOS filename conventions were used. This greatly simplified the
Case Study #2: Sales Training

Interactive Media Corporation was recently involved in the design and development of 50 hours of WBT for a telecommunications company (with less than six month's time from start to finish). The instruction was designed for a company intranet that resides behind a firewall, but many of the learners access the courseware by dialing in through a 28.8 modem. Microsoft Internet Explorer 3.02 or higher was selected as the browser (by the company). Some of the design decisions included:

- In order to minimize the "opportunities" for the learners to navigate to other sites, the Internet Explorer menu bar was hidden by using Javascript commands.

- Due to the bandwidth limitations inherent in the dialup connections, media elements (audio and animations) were used only where deemed appropriate and most effective for content presentation. Video was not used in this training.

- In order to create over 2,500 HTML documents in a very short time frame, the development approach consisted of storing the storyboard information in a database, reading the data from the database with Active Server Pages, and automatically generating HTML pages.

- Bandwidth limitations and load time were mitigated as much as possible via efficient design and development strategies (small, tiled background graphics, re-use of existing graphics, etc.).

- A frame-based design was implemented that provided static menu options on the left side of the screen. All of the pages are designed to fit into an 800X600 resolution display without scrolling.

- A combination of tutorial, explore, simulations, and gaming strategies were employed throughout the program to educate and motivate the learners.

- A theme related to travel was used with learners taking a virtual World Tour to Chicago, Venice, Athens, Tokyo, etc. At each site, they were presented with activities in the form of "adventures"--successful completion of the end-of-module test allows the learner to receive his or her "ticket" to the next adventure.

- Student assessment was tracked through a database. Mastery of the objectives through performance on the posttest was required for course completion (and further on-site training).

- Just-In-Time (JIT) modules were included to provide continual support (in the form of electronic job aids) when the learners completed the formal training.
Summary

The World Wide Web offers an effective method for disseminating information, education, and training. The categories include e-mail correspondence courses, Web-enhanced instruction, Web-management instruction, and Web-based Training. If Web documents are properly designed, they will be appealing, interactive, and offer an easy-to-navigate interface. By observing a few guidelines, instructional designers can help make the transition to world-wide training a smoother road.

Discussion Points

As "discussion starters" it might be worthwhile to post comments about the design of the following sites to the ITForum. Discussion points might include:

• What elements of the site would you consider well-designed?
• What elements of the site would you change, and how would you change them?
• Which authoring tools were used to develop the site? Are they appropriate?
• Did you run into any error messages or conflicts in running the program? If so, how could they be avoided?
• Are the interactions included on the site meaningful? If not, how could they be improved?

Example WBT Sites

Cyber Travel Specialist  (frame-based)

Go to http://cybertravelspecialist.com/ and click on Demo Lesson

Digital Think  (frame-based)

Go to http://www.digitalthink.com  and "Click here for a free Internet search course"

Doctor's Dilemma  (frame-based)

http://www.ddonline.gsm.com/
Dterm Series III Online User Guide (frame-based with RealVideo)

http://userguide.iliibrary.com

Gartner Learning Group (page-based)

Go to http://www.gglearning.com and click on Demo Course.

HHMI Virtual Lab (frame-based with embedded Shockwave Authorware)

http://www.hhmi.org/grants/lectures/vlab1

HIV Lifecycle (frame-based with embedded Shockwave Flash)


How to Screw in a Light bulb (a classic produced with Shockwave Authorware)

http://www.sageinteractive.com

Integrity Training, Inc. (screen-based; produced with Shockwave Authorware)

http://www.integritytraining.com/courses

Interactive Patient (page-based)

http://medicus.marshall.edu/medicus.htm

Intranet Learning Center (page-based)

http://www.intramark.com/frontend/menu.htm

NASA Web Interactive Training (page-based)

Go to http://wit.ksc.nasa.gov/html/courses.html and click on "Introduction to Technology Transfer@KSC"

Radiologic Anatomy Interactive Quiz (page-based; developed with Java)

>http://www.gsm.com/resources/raquiz/
Go to [http://www.slac.stanford.edu/esh/training/study_guides/study_guides.html](http://www.slac.stanford.edu/esh/training/study_guides/study_guides.html) and select one of the options for Course 219.

**Sticky Situations** (screen-based; developed in *Authorware*)


### References and Other Resources


Gamelan (examples of Java, Javascript, ActiveX, etc.) [http://www.gamelan.com](http://www.gamelan.com)


Multimedia and Internet Training [http://www.multimediatraining.com](http://www.multimediatraining.com)


### About the Author

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Ann is also the Vice President/Chief Technology Officer with Interactive Media Corporation. She has worked with this company (and its parent company, Analysis & Technology) since 1989. She has been involved in the design and development of multimedia courseware, WBT, and training for the Royal Australian Navy, U. S. Navy, NASA/Lockheed, Veteran's Administration, MCI Corporation, Pacific Bell, USAirways, and numerous other companies.