Adobe Acrobat: An Alternative Electronic Teaching File Construction Methodology Independent of HTML Restrictions

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The goal of the project was to create a method by which an in-house digital teaching file could be constructed that was simple, inexpensive, independent of hypertext markup language (HTML) restrictions, and appears identical on multiple platforms. To accomplish this, Microsoft PowerPoint and Adobe Acrobat were used in succession to assemble digital teaching files in the Acrobat portable document file format. They were then verified to appear identically on computers running Windows, Macintosh Operating Systems (OS), and the Silicon Graphics Unix-based OS as either a free-standing file using Acrobat Reader software or from within a browser window using the Acrobat browser plug-in. This latter display method yields a file viewed through a browser window, yet remains independent of underlying HTML restrictions, which may confer an advantage over simple HTML teaching file construction. Thus, a hybrid of HTML-distributed Adobe Acrobat generated WWW documents may be a viable alternative for digital teaching file construction and distribution.

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JAFFE AND LYNCH¹ recognized that learning radiology from computers should be "natural" for a specialty that relies heavily on computer-generated images, and that it "... is an ideal medium for classroom-independent training." Reviews have unquestionably described computer-assisted instruction (CAI) as a great means of disseminating radiology images and education.¹⁻³ Although much effort has produced many viable and different methods of CAI, an historical problem has been the wide use of 2 different commonly used operating systems (Macintosh OS and Windows), which may be mutually exclusive in software application. This has been problematic especially for in-house-produced software or teaching modules.

Digital teaching files (DTF), a subsection of CAI, can be defined as hand-selected visual content that has value added through annotations, notes, field-specific vocabulary, textual discussion, and references to other material. DTF currently are produced via a myriad of methodologies; however, a majority have now been constructed using hypertext markup language (HTML), the program-

ming language of the Worldwide Web (WWW). This generates files that can be viewed within a browser on either the Macintosh, PC, or Unix platforms, albeit slightly differently in overall appearance. Unfortunately, with the advent of HTML version 4.0, many HTML instructions have been deprecated in favor of a new format called "cascading style sheets" (CSS).⁴ In fact, HTML historically has undergone significant changes with each new version. Thus, radiology teaching files created with older HTML code may not be displayable by future browser software. In other words, we easily may find ourselves in a situation in which our presentation software becomes outdated before the radiologic images do.

Acrobat is a suite of programs developed by Adobe Systems for creating and distributing electronic documents. Programs in the suite allow one to create a document that appears identical on all platforms (including Macintosh OS, Windows, and Unix-based computers), which can then be distributed electronically. Recipients can view the document with the Acrobat Reader software, which is distributed to anyone free of charge. Any file, be it a simple graphic (scanned or digitally created), word processor file, PowerPoint presentation, or even WWW site, can be converted into an Acrobat file.⁵

Using Adobe Acrobat, the goal of this project was to create a method by which electronic teaching files could be constructed easily and quickly in a form that confers independence from HTML restrictions, yet still retains the ease of use and ubiquity of the WWW. The methodology to achieve this goal is presented, and issues of hardware and software utilization as well as caveats are addressed.

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MATERIALS AND METHODS

The computer platform utilized was an Apple (Cupertino, CA) Macintosh PowerPC G3 with a 13 GB internal hard-drive, 128 MB RAM, an internal CD-ROM and Iomega (Roy, UT) Zip drive, as well as 16 MB of video RAM. A Nikon (Melville, NY) 35-mm Coolscan slide scanner and Hewlett Packard (Palo Alto, CA) ScanJet flatbed scanner also were utilized. A 17-inch monitor was selected for its large viewing area. All components were purchased as off-the-shelf items at a local computer superstore or online and did not require any special skills for installation. The system was connected with the hospital local area network (LAN) allowing access to the internet and enabling the possibility of file distribution. It should be noted that although Macintosh was the platform chosen by the author, the same software installed on a PC running Microsoft (Redmond, WA) Windows would have yielded the exact same results, because Microsoft PowerPoint and Adobe Acrobat files are now recognized by both platforms regardless of that used for initial file origination.

Images were obtained from various sources including scanned 35-mm slides, scanned hard-copy images, as well as via capture from teleradiology systems, PACS, and image workstations.

Adobe (San Jose, CA) Acrobat (initially version 3, upgraded to version 4) was purchased and installed. This software produces "Portable document files" (PDF). Adobe Photoshop (initially version 5.0 upgraded to version 5.5) was chosen for image manipulation and the shareware JPEGView for simple image display. For word processing, spreadsheet construction, or slide presentation needs, Microsoft Office (which includes Word, Excel, and PowerPoint) also was installed. All software was purchased appropriately before installation, and licenses were retained.

Radiologic images to be used were appropriately sized with Photoshop and saved in joint photographic experts group (JPEG) format. JPEG images used were 72 dpi, with as much JPEG-compression as possible without introduction of artifact by simple visual inspection. Using Microsoft PowerPoint, teaching files were constructed using these images as if one was building an ordinary 35-mm slide presentation. After completion, Adobe Acrobat then was used to convert the PowerPoint file into a PDF document file and also to perform subsequent fine-tuning functions on the teaching file such as cropping, setting magnification, linking between pages, and setting display parameters. Finally, all PDF electronic teaching files constructed were tested on Windows, Macintosh, and Unix-based computer platforms, as both a free-standing file as well as from within a browser window.

Many options are available within the Acrobat software that allow for wide latitude during the production stage for how a file ultimately will behave and appear. For purposes of this report, methodologies were kept simple, because that was one of the ultimate project goals. Cropping was performed on each Acrobat page to rid the DTF of white space introduced by the software during the conversion process. Pages were linked together using the "link" tool, which enables users to choose images from thumbnails, as well as to allow forward and backward movement from within the DTF. "Link" utilization also allowed for jumping from section to section, and for testing on DTF findings: incorrect choices directed to a page stating so,

whereas a correct choice directed to the next DTF section. Movie insertion was used for DTF cases incorporating either animated GIF movies or for video capture from ultrasound studies.

It should be noted that a detailed stepwise discussion of the software used is beyond the scope of this publication, because the goal is to discuss Acrobat DTF construction as compared with purely HTML-derived documents, and not to provide a step-by-step how-to document. For the latter, readers are referred to appropriate tutorials or manuals included with the various software packages.

RESULTS

The described methodology allowed quick and easy construction of PDF digital teaching files. Building the initial PowerPoint presentation required the same amount of time as would any 35-mm slide presentation, which would vary from author to author dependent on their individual experience with PowerPoint. The extra step of Acrobat conversion and manipulation added only a small amount of time as compared with that needed to construct the initial PowerPoint presentation itself. The actual conversion step itself took only seconds. It should be noted that PowerPoint presentations were chosen as the starting material because it is familiar to most academicians, and also is usually readily available within departments. However, virtually any file can be chosen as the source of PDF material; if a file can be printed, it can be converted by Acrobat. This process is summarized visually in Fig 1.

Computers utilizing various versions of Windows, Macintosh OS, as well as the Silicon Graphics Unix-based OS, all displayed PDF teaching files identically, without any need for interpretation or translation, using the free Acrobat Reader software. PDF files also were viewed within browser windows on the various platforms, again appearing identically, utilizing the free Acrobat browser plug-in.

DISCUSSION

CAI materials are varied, multiplatform, and are growing quickly. There are many publications that describe in-house design of educational software, some of which are targeted to a very specific area of interest. These include many "tutorials" used to teach a plethora of topics: magnetic resonance imaging (MRI) physics,⁶ explanation of x-ray simulations for technologists,⁷ arthritis,⁸ MRI of the knee,⁹ color doppler,¹⁰ imaging the spleen,¹¹ and

Fig 1. Flowchart shows possible source material for PDF electronic teaching files as well as the 2 methods by which they can be viewed. One method uses the Acrobat Plug-in for internet browsers to enable downloading from a WWW site and viewing from within a browser window. The second method displays the PDF file via Acrobat Reader software as a free-standing file, independent of internet browsers.

even "Teaching Visual Thinking in Radiology."¹² Some of these have taken a form of "electronic textbooks,"¹³ utilizing interfaces that appear in a familiar book format, but displayed on a computer.

To date, a majority of DTF, a subsection of CAI, have been constructed using HTML, the programming language of the WWW. This generates files that can be viewed within a browser on a Macintosh, PC, or Unix-based platform. Many radiology web sites now exist, hosting a collection of teaching files that encompass all modalities and describe a multitude of disease processes. Some of these have been described within the literature.¹⁴⁻¹⁶

A minor disadvantage of the HTML technique is that web page appearance varies when displayed by different software; for example, with Microsoft Internet Explorer (Explorer) versus Netscape Communicator (Communicator). As well, web page display by a single specific browser will vary between different platforms: for example, Explorer

displaying a web page under Macintosh OS versus Windows 98 operating systems. Because of this, when designing WWW pages, one should check file appearance on both Explorer and Communicator, as well as on both PC and Macintosh computers before internet distribution. This can add a significant amount of time as well as frustration. Additionally, some of the interactive components incorporated within HTML pages, such as dynamic HTML (dHTML) and JavaScript, are supported differently or not at all, on one browser as compared with the other. This cross-platform and cross-software testing may add more time to DTF construction itself, yet, is a necessary step to ensure all users are supported. For radiologists producing their own DTF without close technological support, this may prove time costly and frustrating.

A major disadvantage of the HTML technique resides in the way web page code is written and subsequently displayed. An explanation of this will necessitate a brief discussion of HTML programming. To display text and pictures on a web page, various programming commands are used called *tags*, which tell the browser software where to put something and how it will appear on a web page. For example, to have a statement such as *Teaching File Number 1* in bold face, colored blue, in Geneva font, and centered on a line, requires separate tags for each option in the first 3 versions of HTML. However, the Worldwide Web Consortium (W3C), which is the governing body that decides the standard programming language for the WWW, has changed this for the fourth version of HTML (HTML 4.0). Such display commands now have been deprecated, which means HTML 4.0 currently will recognize them, but they are discouraged from use as future HTML versions will not support them. Instead, the W3C is moving all page display attributes to "cascading style sheets" (CSS).⁴

What does this mean for WWW pages (hence DTF) that are written using the first 3 versions of HTML? To be able to read them, future versions of web browsers will need to be compatible with old, as well as then current, versions of HTML, which will likely be the case for a period of time. This will result in increasingly bloated browser software, and, eventually, older HTML versions will no longer be supported. Thus, all the web pages available today will be read in the future, however,

for an unknown period of time, after which they will become obsolete and displayable only by old nonsupported browser software. Logically and historically speaking, CSS itself likely will be replaced eventually by an as-of-yet unknown successor. Interestingly, it is this plasticity and flexibility of HTML that allows rapid adoption of technologic advances, yet, at the same time, quickly outdates that which has gone before. Truly, HTML is a language best used for contemporaneous, but not archival, use.

Adobe Acrobat can be used to construct electronic teaching files that are platform independent and also are free of HTML restrictions. This software produces PDF files that can be read using the free Acrobat Reader or browser Plug-in software on Windows, Macintosh OS, and Unix-based computers. Adobe Acrobat constructs documents that appear 100% identical on all platforms regardless of fonts or software used during initial production; if a file can be printed, it can be converted to an Acrobat file. With the newest version of Acrobat (version 4), web sites (including web-based DTF) can be captured and converted into PDF files. As well, Adobe provides a free online service¹⁷ that performs PDF to HTML conversions, which can be read by many screen reading programs utilized by visually disabled users. At the time of this writing, well over 250,000 web sites utilized this platform for distributing information, and the software was available in 14 languages, including Asian character-based languages. The best example of use for medical information dissemination is at the University of Washington Health Sciences Libraries where desktop delivery of journals in PDF format is offered via the WWW as a standard option.¹⁸ Currently, Acrobat software is used by businesses, governmental agencies, organizations, educational institutions, and individuals worldwide. It has become the defacto standard by which documents are distributed electronically.⁵ Although Acrobat does add an initial cost for those creating PDF teaching files, this cost is small, and no additional cost at all is incurred by the end user.

HTML-based DTF are interactive, incorporating features that involve the user. For example, a page can be filled with thumbnail images, which then are linked to a larger screen-sized image, allowing the user to select those images of interest at a glance. This ability is also present within Acrobat files via the "link" tool, and operates no differently

than HTML links. HTML-based files also become dynamic documents via the use of Javascript or sound, both of which also can be incorporated within an Acrobat document. A few WWW DTF sites enable image grayscale manipulation or zoom/pan capabilities via Java applets, which unfortunately are not supported within the current version of Acrobat.

A drawback of this technique derives from the fact that HTML is learned easily and now can be written with any modern word processor. This, in essence, produces an easy and essentially free method to quickly construct web pages with images for teaching files, to be used on both the internet or via an intranet. However, one can still take advantage of WWW ubiquity and ease of use by utilizing the "Plug-in" capability of browser software with the Acrobat browser Plug-in. In this manner, it is the Acrobat Plug-in that displays the PDF teaching file within the browser window, not the browser itself, and it is thus independent of the underlying web page HTML code version. The Adobe browser Plug-in that performs this function also is free of charge, and is installed automatically when one installs the free Acrobat Reader software. Given the extensive installed base of Acrobat files throughout the world, and that this format has become a standard method for electronic file distribution, it is a safe assumption that Adobe will continue to provide support and upgrades in the future for both the plug-in as well as production and Reader software. Additionally, with each version of Acrobat that has been released, complete backwards compatibility has been maintained, thus, to date, no Acrobat file can be considered obsolete, and there is no reason to believe the company will alter this direction given its success. Regardless, one also must realize that this represents proprietary software from a private entity, which is subject to market and economic pressures, and could change or be abandoned at any time.

Another criticism of this technique lies in the method of electronic file transfer. When viewing a WWW page, only those elements necessary for a specific page are downloaded at a time. Thus, when reviewing an HTML DTF that is several pages in size, only the data immediately needed is transferred, and only at the time it is needed. With Acrobat files, the entire file is transferred to the Plug-in or program, resulting in a delay from initiation to the time of actual viewing. If one wishes to view an

entire teaching file, the time for PDF download is likely no longer than the total time needed to download each and every page of a WWW document. However, if only portions of a teaching file are desired (for example, just images and a diagnosis), the PDF manner of data presentation would cause a distinct delay and, thus, disadvantage. However, as wider bandwidth becomes more commonplace, this disadvantage will diminish as download times become less.

A technique has been presented for constructing electronic teaching files using off-the-shelf hardware and software. Adobe Acrobat, which appears identical on any platform and is utilized by hundreds of thousands of web sites globally in many different languages, takes great advantage of the Plug-in capability of web browsers to display PDF files independent of the underlying HTML code. Thus, the advantages of internet/intranet WWW ubiquity are preserved. Consideration for long-term use of electronic teaching files will necessitate cautious selection of the presentation software we use. If we are not careful, we easily may find ourselves in a situation in which our computer presentation software becomes outdated before the displayed radiologic images do. Given these caveats, a hybrid of HTML and Adobe Acrobat generated WWW documents may be a viable alternative for DTF construction and distribution.

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