Echo360: Lecture Capture Solutions for Students with Disabilities
By Pat Brogan, Ph.D.
January, 2009

Campuses today are implementing programs using technology to provide broader access to instruction and at the same time giving students more control over their learning experience. Legislation mandates that students with disabilities be accommodated, but there are few solutions that address a wide range of needs. As campuses are faced with increasing budget issues, they are forced to try to accommodate students with less.

Estimates are that 20% of the population typically has or will have a temporary or permanent disability that can impact learning. The types of disabilities represented in higher education can be seen in Table 1.

Note: Freshmen could report more than one disability
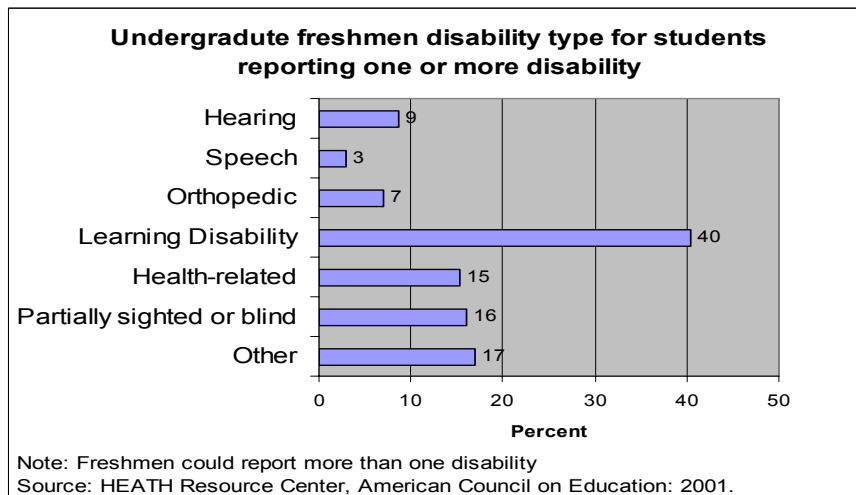Source: HEATH Resource Center, American Council on Education: 2001.

Table 1: Types of disabilities in new undergraduate students, HEATH Resource Center

Research today shows that enrollment rates as well as matriculation rates for people with disabilities is far lower than the general population.

The financial impact on society is significant, since the poverty level of people with disabilities is five times that of the general public. It is in society's best interest to provide education and jobs for people with disabilities. By making educational materials, as well as degree programs available to students with disabilities, the benefits to society and to these individuals is significant.

The Mandate for Compliance: Sections 508 and 504

On August 7, 1998, in president of the United States signed the Workforce Reinvestment Act of 1998, which includes the Rehabilitation Act Amendments of 1998. Section 508 of the Rehabilitation Act, as amended by the Workforce Reinvestment Act of 1998, requires that U.S. Federal agencies develop, procure, maintain, or use electronic and information technology which lets Federal employees with disabilities have access to, and use of, information and data in a comparable fashion to those without disabilities. This legislation is commonly referred to as "Section 508". The only exception is when an undue burden would be imposed on the agency.

Section 504 of the Rehabilitation Act of 1973 is a federal law designed to protect the rights of individuals with disabilities in programs and activities that receive federal funds from the U.S. Department of Education (ED). Section 504 provides: "No otherwise qualified individual with a disability in the United States . . . shall solely by reason of her or his disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance . . . ." One aspect of section 504 is the requirements for making programs accessible to individuals with disabilities and for providing equally effective communications. It also sets forth standards for what constitutes discrimination on the basis of mental or physical disability, provides a definition of disability and qualified individual with a disability, and establishes a complaint mechanism for resolving allegations of discrimination.

Several states and educational system have implemented their own guidelines and mandates which take the compliance mandates further. Examples include California, which has set the most stringent guidelines for publishing content that is accessible. The California State University policy statement on accessibility was articulated in Executive Order 926, along with the tasks and timelines. The order and University policy be viewed at http://www.calstate.edu/accessibility/. California has gone a step farther to support the concepts and implementation of Universal

Design, which is paying back with improvements in gradation rates and grades of students with disabilities. The Accessibility initiative support website (http://www.sonoma.edu/accessibility/) has rich resources, workshops and survey data. States with additional mandates include: Arizona, Arkansas, Colorado, Indiana, Kentucky, Louisiana, Illinois, Maryland, Minnesota, Missouri, Montana, Nebraska, North Carolina, Texas, Virginia, West Virginia, and Oklahoma.

While Universal Design and retrofitted content compliance can be difficult to achieve, one aspect of the regulation provides that efforts should be made to provide equivalent functionality. How this is implemented is not mandated, though there are guidelines that specify how web delivered content should be developed to provide the optimal experience for as many of the special populations as possible. The concept of "Universal Design" takes the accessibility initiatives a step further: with Universal Design Principles, personalized learning at the core. Universal Design deals with providing students clearing learning outcomes, materials, access to instructors in ways that meet individuals' needs for representation, engagement and expression.

The World Wide Web Consortium (W3C), the international organization that sets standards for the Web, has made accessibility a major initiative with its committee, the Web Accessibility Initiative (WAI). The WAI leads several working groups that have developed checkpoints and guidelines for accessibility that have been referenced and adopted by governments and organizations around the world. The most widely adopted of all of these guidelines and standards are the Web Content Accessibility Guidelines Consisting of 14 guidelines and 64 checkpoints, this document serves as the basis of almost every major standard around the world. These checkpoints serve as the basis of worldwide standards.

Lecture Capture: Supporting the Mandate and goals of Universal Design

The practice of recording audio and video material from university lectures to make them available online for students to access has been repeatedly acknowledged as having significant benefits for a large proportion of the student population (Laurillard, 1993; Bligh, 2000; Biggs, 2003). Students with learning styles not necessarily suited to the face-to-face lecture method, students with disabilities or medical conditions, international students, and those with significant work or domestic pressures have overwhelmingly welcomed the opportunity to gain access to lecture recordings online (Williams & Fardon, 2005). Once a lecture is

recorded, students are empowered with a greater level of control over the material presented, allowing them to review the material at their own pace and in an environment in which they are comfortable.

Type of Disability	Lecture Capture Feature(s)	Impact to Student	Impact to Campus
Physical/orthopedic	Review anywhere	Access to classes	Attract & matriculate more students
Hearing	Close Captioning (CC)	Access to audio as text	Reduce need for sign language interpreters, searching text
Speech	User controls over audio, CC	Control audio, visuals	Supports language processing, ESL
Learning	User controls playback	Control replay in privacy	Reduce the need to send note takers to class, tutoring more effective, lowers faculty office hours
Health Related	Playback controls	Control replay in privacy	Improvement in retention students and learning
Vision	Screen reader support	Replay the lecture with screen reader	Improvement in retention students and learning
Other	User controls over audio, CC	Control replay in privacy	Improvement in retention students and learning

Table 2: Types of disabilities and impact of recorded lectures

Williams & Fardon conducted a study at the University of Western Australia as part of a 9 year effort to use lecture capture software to address the needs of students with disabilities. The University of Western Australia created the Lectopia "iLecture" lecture-capturing solution to provide students with the opportunity to review lectures outside of the classroom. The software (now combined with the former Apreso product forms the basis of the Echo360 Lecture Capture System) is deployed at nearly half the universities in Australia.

Ninety-eight percent of the students rated the recorded lectures "essential or very useful". Many students felt that recording these lectures should be mandatory. The study is published at: http://www.utas.edu.au/itr/lectopia/documents/p67.pdf.

Research shows that providing access to lectures outside the classroom benefits most students, not just those with learning disabilities. In surveys, over eighty percent of students surveyed indicate that they would sign up for a class with lecture capture over a class without it

Students with physical disabilities benefit because lecture capture technologies can provide access to classes which they may not physically be able to attend. Students with cognitive disabilities benefit from having the ability to control the playback environment. Students who take classes in their non-native language benefit from having the option to slow down the audio, and to replay it as needed. Vision-impaired students benefit from having the audio recorded for review with screen readers. The use of screen readers like JAWS and Windows Eyes supports the needs of those with visual impairments.

For students with hearing disabilities, the addition of transcriptions and captions enables students to ensure that they are able to get the information. When caption files are added, the caption file is imported into the system and displayed synchronized with the audio and video to give the student the entire classroom experience.

Campuses typically send note takers to support learning-disabled students, and with complete recordings, this need may go away or a note-taker can summarize the lectures from the recordings, or students may not need the summaries. Now tutors can be more effective by giving relevant guidance in the proper context.

Echo360 Architecture and Accessibility

Echo360's software development efforts are aimed at not just to comply with section 508 mandates but to support the concepts of Universal Design. The Echo360 system was tested by an outside agency and certified to be accessible and the playback environment is compliant with section 508 standards.

The design of Echo360 playback environment supports a variety of learning styles. Echo360 is committed to supporting the needs of all learners. The specifics of how echo360's products comply with Section 508 are included in the Echo360's VPAT (Voluntary Product Accessibility Template, available at http://www/echo360.com).

Echo360 Overview

The Echo360 system includes components that allow the automation of the scheduling, capturing, packaging publishing and distributing recorded content.
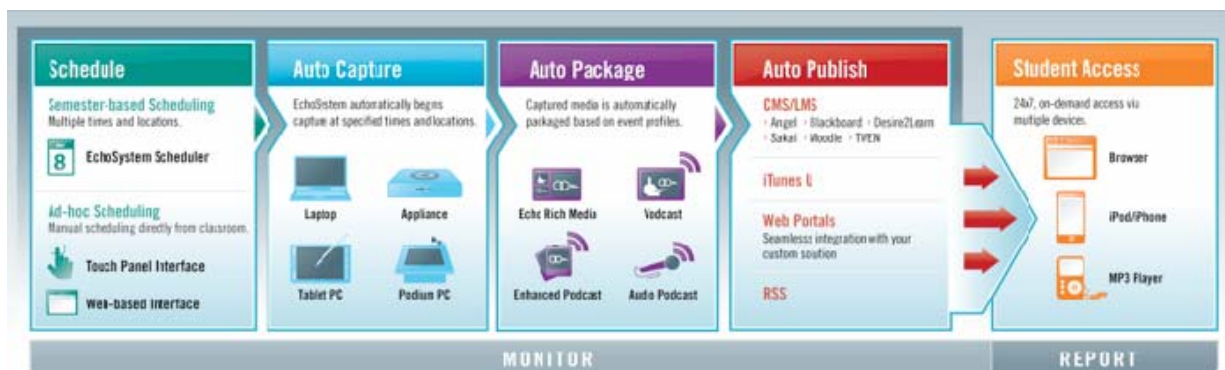

Figure 1: Echo360 Workflow

The Echo360 system generates a variety of file-types for playback on the web or on mobile devices like the popular iPod or iPhone. Format types include a podcast (audio only) file, an enhanced podcast, which includes the audio and thumbnail images representing classroom visuals, a VODcast, which includes the audio file plus image visuals which playback at five frames per second. The full rich-media Echo360 playback environment is designed to be viewed in a web browser, and is typically streamed using a media-server.
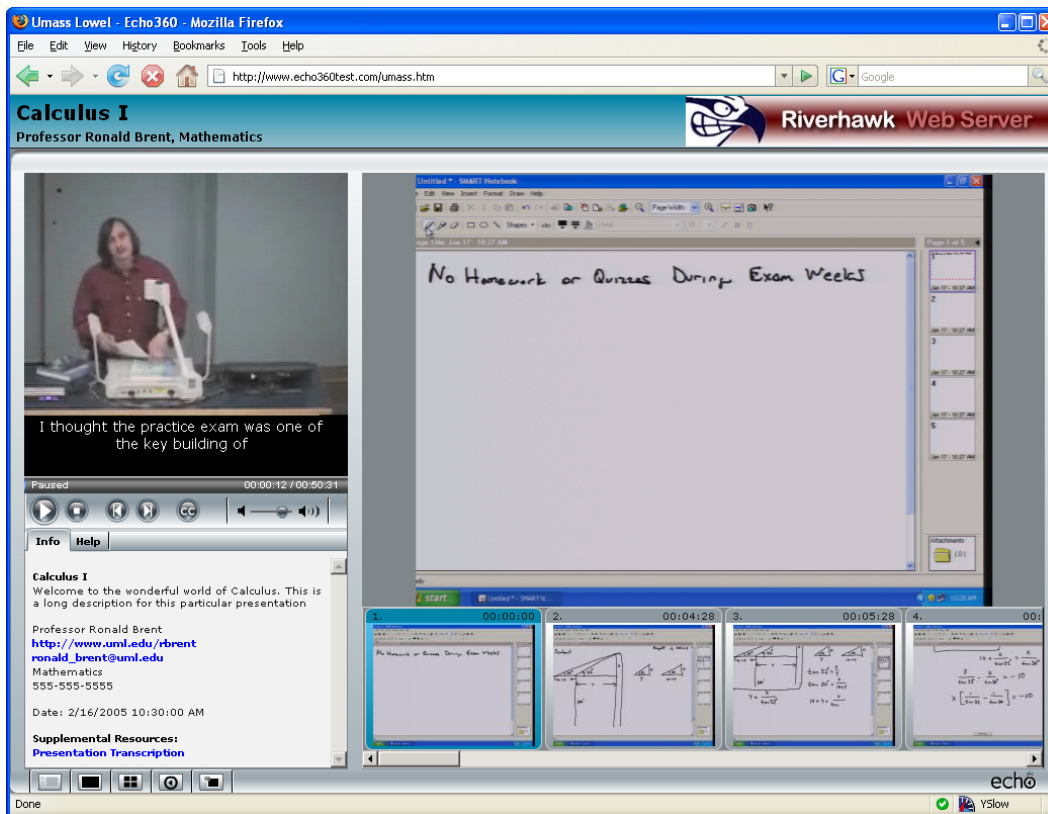
Figure 2: Echo360 Playback with captions

Figure 2 depicts the components of a rich-media Echo. These include a video window, which can be enlarged or hidden, as desired by the user. The video window is often a recording of the professor, the blackboard, or a procedure. The second window area includes classroom visuals which typically come from the stream of data which is projected in a classroom. This can include PowerPoint presentations, input from document cameras or tablet computers. Users may select to make this window "full screen" or to hide it. These windows are synchronized with the audio files. Classroom control systems can be used to select the visual output and the stream that is sent to the projector is recorded.

Audio files are captured via a microphone. They are recorded and stored in either a .aac or .mp3 file format. These audio files can be used to generate a transcription and a caption file which can be displayed synchronized with the video and visuals. The caption file is displayed by clicking on the "CC" button, which opens a three line window under the video, as seen in figure 2. A transcript file can be sent along with an audio file for reading. Once the audio file is captioned, search engines can be used to perform keyword searches within a lecture and across a lecture library.

http://www.echo360.com 7

Learning theory indicates that many students, not just hearing impaired students, benefit from having access to both text and audio, as it appeals to two senses. Students with English as a second language benefit from seeing words in writing as it reinforces their written language skills. If the instructor speaks with an accent, students can rewind the instructor to repeat the word or phrase they missed.

The caption area can additionally be used to display a foreign language translation of the audio. The decision to transcribe or translate is largely dependent on how the content is to be used, cost and quality needs. In some cases, the mandate is to caption everything that gets published. Most campuses do not have adequate budget to caption all lectures. Table three shows the considerations for the different types of content to be captured.

Type of content	Shelf Life	Volume	Translation and or transcription
Lectures	Short	High	Maybe
Supplemental learning	Long	Low	Yes
Distance learning	Short or long	Low	Yes
Events	Long	Low	Both
Student content	Short	Low	No

Table 3: Considerations of captioning

Automating the Captioning Workflow with Echo360

The campus will decide first on what they want to caption. If the goal is to be section 508 compliant, then developing an accurate transcript or caption file is critical. For high quality recordings, manual transcriptions and captioning processes are generally used.

There are three popular models of supporting deaf and hard of hearing students in classrooms today. These include:
- Sign language interpreters
- CART real-time captioning systems
- Recording and captioning audio and visual materials in a post-production mode

Sign language interpreters can be videotaped, as in the example at Gallaudet University, depicted in figure 3. The signs can be captioned and synchronized with the video. A recent accessibility workshop held at Gallaudet University can be viewed at: http://www.echo360.com/news-events/echo360cast.asp. At this workshop (and in the recording) Phil Bravin, former board member of Gallaudet as well as former CEO and President of National Captioning Institute talked about the issues of captioning and making content accessible. Earl Parke from Gallaudet presented their use of accessible lecture capture, as did Phyllis Tutora from George Washington University. Jocasta Williams presented her multi-year study of using lecture capture tools for disabled students at the University of Western Australia. Mike Fardon, VP of Products at Echo360 discussed and showed the power of the system.

Captioning from recorded audio files are generally offered by captioning services, like Automatic Sync Technologies (AST) http://www.automaticsync.com/, a partner of Echo360. Automatic Sync was funded by a Department of Education grant to examine how to make captioning process more efficient. They evaluated techniques, cost structures and emerging technologies. Their research conclusions were that significant improvements were possible using automation but human stenographers could not be replaced with speech recognition tools with any acceptable degree of accuracy

AST built a system that automates all the steps that can be automated. This includes the workflow to and from an automated lecture capture system, like the Echo360 system. The automated workflow simplifies the process and allows for larger scale rich media projects to be made accessible, at significantly lower costs and with faster turnaround.

The process includes selecting a publishing point for each class, similar to the method used to create the automatic publication to Blackboard or iTunesU. In order to generate a caption file, a transcript must be generated from which the captions are created, along with timecodes which allow the file to be synchronized with the audio, video and visuals.

Captioning and transcription services can be selected, along with a variety of relevant output formats. These range in price from around $100 per hour for a caption-only file to considerably higher costs depending on the format types requested and the urgency.

The recorded lecture is identified as a target to be captioned and or transcribed and the file is then uploaded automatically to the captioning service, Automatic Sync Technologies. The file is uploaded to the Automatic Sync server, sent to a human to be captioned, and the imported captioned file is automatically uploaded into the Echo system server where it is associated and synced to the audio, video and visuals, as seen in figure 3. The integrated file is played back using a Flash streaming server, which delivers the rich-media lecture containing the audio, visuals, video and caption file.
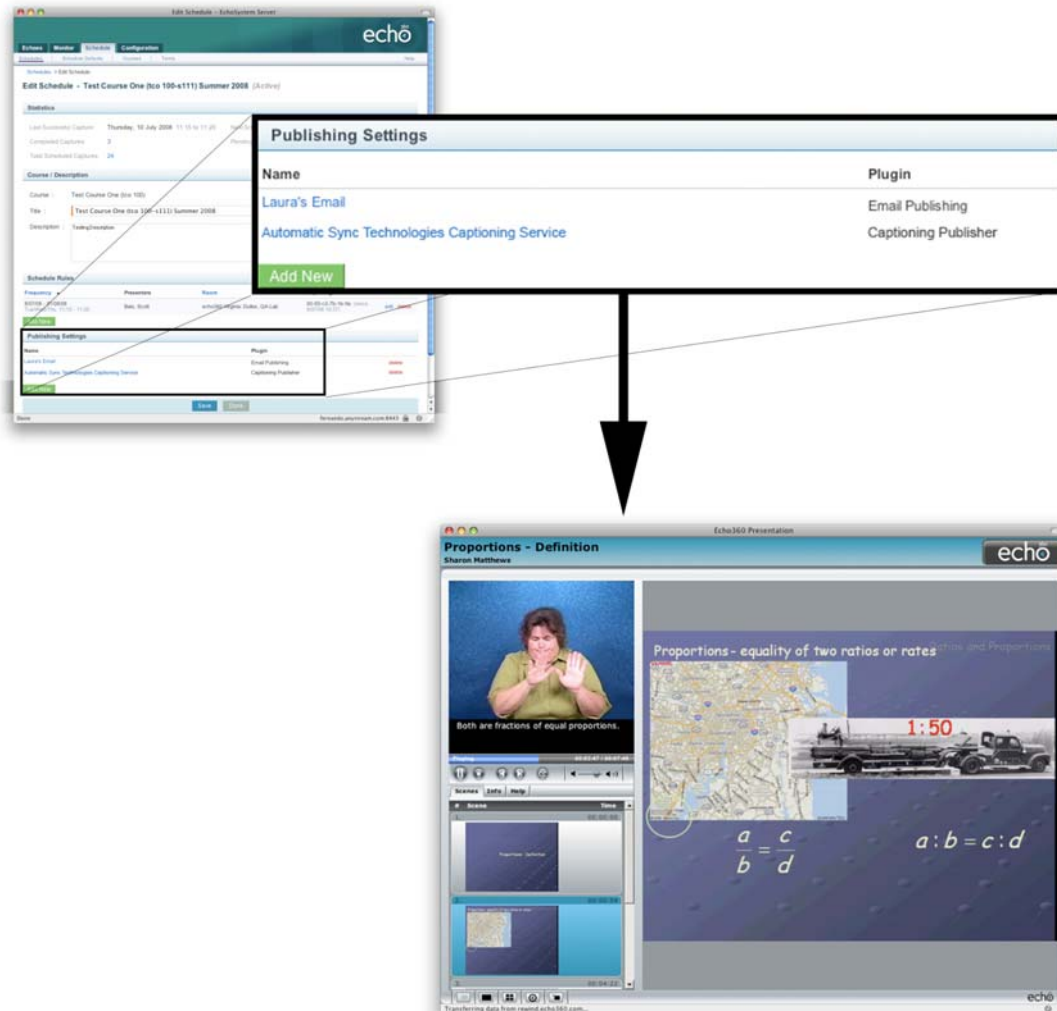
Figure 3: Workflow in Echo360 to publish a file for captioning

To watch a video recording of the integration process, visit:
http://www.automaticsync.com/caption/echo.htm.

For a software license fee as low as $10,000 per year, the Echo360 Podcasting software automates the capture of all audio files for each class. These files can then be published as .aac or .mp3 files, or they can be sent to a service or software tool for transcribing. This eliminates the need to manually record each class. Where classroom graphics are desired, the system can be set to create enhanced Podcasts or VODcasts.

Students with visual impairments benefit from selecting the option in the Echo360 playback window "screen reader" version, which allows the content to be viewed using the popular tools Window-Eyes http://www.gwmicro.com/ or JAWS http://www.freedomscientific.com/.

When a student selects the high-speed or low-speed playback, the Echo360 System will show some combination of playback controls, video, thumbnails, and VGA display (depending upon the type of presentation capture that the user chose). The screen reader playback option shows the playback controls and the VGA display, and adds a new series of buttons that gives the user the option to skip to specific points in the presentation as seen in figure 4 below, which shows an example of the screen reader playback. The major difference between this version and the "sighted" versions, however, is not visible at all.
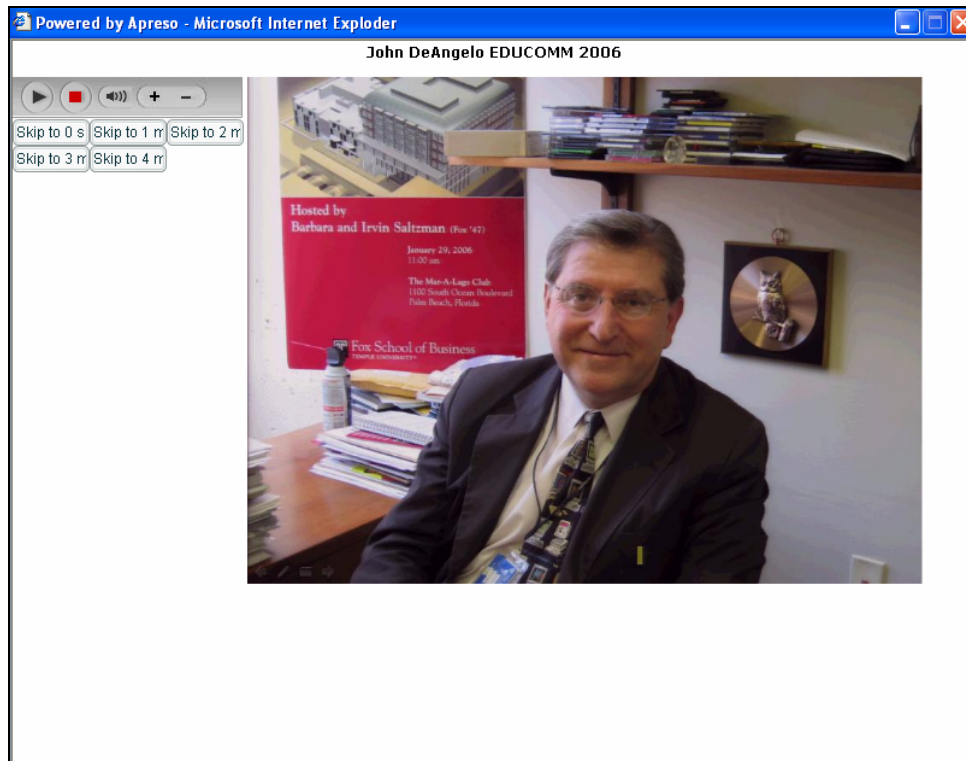
Figure 4. Screen Reader Playback Screen

Hidden in each of the screen elements (an element being a window, a frame, a button or checkbox, and so forth) is a brief description of that element. The screen reader will step through each of the elements on a web page and read those hidden attributes to the users, so that they can know what is available on a page, and what options they have for controlling their interaction with the web page.

In a September 2008 article in the publication Inside Higher Ed http://insidehighered.com/news/2008/09/23/capture, a study at the University of Wisconsin of over 29,000 students found that almost half the students watched the recorded lectures and found them to be invaluable for when they had to miss class, and for reviewing materials outside the classroom. Studies show that most students will select a class with lecture capture over one without it.

References and Resources:

Government 508 legislation http://www.section508.gov/

The W3C's Checklist of Checkpoints for Web Content Accessibility Guidelines 1.0 http://www.w3.org/TR/WCAG10/full-checklist.html. http://www.lectopia.com.au/news.lasso

Department of Justice accessibility info: http://www.usdoj.gov/crt/508/archive/oldresource.html

Access Board: http://www.access-board.gov/

Department of Ed 508 info: http://www.ed.gov/policy/gen/guid/assistivetech.html

International Center for Disability Resources on the Internet (ICDRI): http://www.icdri.org/section508/section_5 08_resource_page.htm

Web Accessibility Initiative http://www.w3.org/WAI/Resources/

Association of Higher Education and Disability AHEAD http://www.ahead.org/