

Audio and Video to Enhance the Online Classroom

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While the written word typically delivers the main substance in online classrooms, audio offers "content on the go" so the student can listen to course content while doing some other tasks, and video can show processes or interviews with professionals. Both offer a kind of personalization not experienced through only reading the written word. Planning how, when, and where to add these items is an important first step for the instructor, with guiding principles to meet accessibility needs and Intellectual Property matters to consider. A review of mostly free tools available to get the job done is included.

Keywords: Audio, Content Delivery, Development Tools, Video, WCAG

Introduction

Today's online classroom is a pastiche of text, imagery, audio, video, and interactive modules for both synchronous/asynchronous participation. Some colleges leave curriculum design and delivery to the instructor, but where curriculum is standardized, these elements may already be in place thanks to institutional rules and curriculum experts. Instructors may still be able to augment learning through audio and/or videos to present real-world examples, demonstrate processes, reinforce textbook concepts, or introduce related topics.

In addition to aiding with memory and comprehension, audio and video improve motivation and encourage active rather than passive participation (Cabaleiro-Cerviño & Vera, 2020). Interactivity helps develop critical thinking, a personal connection to content, and development of soft skills such as listening, and there is a "utility of vividness" in visual elements said to "amplify cognition" (Al-Maroof et al., 2022, p. 607). Multimedia can bring about emotional response from facial expressions, vocal timbre, and responses to sounds and textures embedded in memory (Chang & Skarbeck, 2021). It could be argued that multimedia helps to serve different "learning styles," however, this formerly widely-accepted theory is criticized by educators today as unfounded (Reynolds, 2021).

A balance needs to be struck with text and multimedia, with a strong focus on what is most important to retain. Consistency frees the brain to focus more on the topics deemed to be more important (Driggsand & Brillante, 2020). In choosing audio or video course elements, then, the designer must consider how the brain codifies and organizes the information therein. Audio data might be remembered in the order it was presented, and visual information relies on design such as color and font choices; a video would combine all of these potential features (Grewal et al., 2021).

Guiding Principles

"Accessibility" is to ensure those with disabilities have access to the same information as others. Advantages:

- Students with hearing disabilities can review written transcripts or video captions.
- Students with sight disabilities can learn through text read aloud by screen reader devices.
- Students with learning disabilities have an option to review content at a pace that best suits their needs.
- English Language Learners can hear and read at the same time for better comprehension.
- Volume control assists anyone in a loud setting or wishing to keep quiet for others (McCarron, 2021).

The Web Content Accessibility Guidelines (WCAG) are a development of the World Wide Web Consortium (W3C). Basically, information must be delivered in more than one way to meet the needs of a diverse population. Some of actions include providing alternative, descriptive text for images and allowing for navigation via keyboard. Text needs to be large and simple enough for easy readability, and zooming features allow for resizing. There must be no color coding due to a large number of people who have color blindness. Light/dark contrast of the screen's background to text is measured. In addition:

- Audio file transcripts must match what is actually said and include description of any extraneous noises such as laughter (Spina, 2021). Multiple speakers should be clearly identified in the transcript (Spina, 2021). Since video usually includes audio as a component, these recommendations also apply to video modules.
- Video captions, sometimes called subtitles, must be synchronized with the video. "Open" captions means they are permanently viewable, and "closed" is where the person viewing has to click a button to turn it on

and off (Spina, 2021). Automatically-generated captions are possible in Zoom, YouTube, and even PowerPoint; the accuracy can be questioned, however, making human transcription or at least caption editing imperative (Spina, 2021).

Worldwide Laws Regarding Accessibility

United States of America. The Americans with Disabilities Act was (1990, amended 2008) prohibits discrimination in employment, medical facilities, transportation, hotels, theaters, and other facets of everyday life, including higher education (Lowenthal et al., 2020). The Rehabilitation Act of 1973 specifies this for where federal funds are used. Most U.S. colleges and universities receive some government funds (Lowenthal et al., 2020). Complying with Section 504 of this Act requires schools to make separate but equal access to services; Section 508 (updated 2018) dictates technology accessibility including "hardware and software, websites, multimedia such as video, phone systems, and copiers" (Lowenthal et al., 2020, p. 4). The 21st Century Communications and Video Accessibility Act (CVAA) was made law in 2010 and updated previous legislation to cover newer technologies under the Federal Communications Commission. Interestingly, this does not require closed captioning for internet-only videos, but does mandate it for television and shows streamed on the internet (Federal Communications Commission, 2019).

Japan, South Korea, and China. Japan's Basic Act on the Formation of an Advanced Information and Telecommunications Network Society was confirmed in 2000. It places the onus on both the government and private entities to enact the accessibility provisions written therein and to educate the public. The wording makes it clear "every citizen has an opportunity to easily and independently use the Internet and other advanced information and telecommunications networks" ("Basic Act," 2000, Article 3). The Korean Web Content Accessibility Guidelines 2.1 is largely the same set of rules as WCAG (see above) and per The Republic of Korea's Act on Welfare of Persons with Disabilities of 2014, following these rules is a requirement ("South Korean Digital," 2022). China's 1990 Law on the Protection of Persons with Disabilities is on lawbooks, but per EqualWeb, the Voluntary Web Accessibility Standard remains as a recommendation rather than a requirement ("China Web Accessibility," n.d.).

United Kingdom, Canada, and Europe. The Equality Act of 2010 dictates publicly-funded organizations to make websites and mobile apps accessible, and even covers intranet and extranet sites (Akinyemi, 2021). Canada also enforces WCAG through the Standard on Web Accessibility as well as several individual province acts regarding disabilities (Akinyemi, 2021). All EU members must follow EN301 549 regarding publicly funded technology, medical data, mobile apps, websites, devices, multimedia, etc. The 2016 Web Accessibility Directive enforces this in public sectors; WCAG will be implemented by June 2025 (Akinyemi, 2021). Some member countries also have their own laws, such as France's Law No. 2005-102 Article 47, Germany's Disability Equality Act, and Italy's Stanca Act; Spain has several laws and decrees (Akinyemi, 2021). Other countries worldwide have similar laws and regulations.

Intellectual Property Issues

Copyright issues must be considered if using someone else's audio, images, background music, or video. U.S. Copyright protection begins at the moment of creation, when it is "fixed in any tangible medium of expression" and the originator retains control for copying distributing, displaying work, and producing derivations (Wolff & Gross, 2017, p. 20). *Linking* to items instead of *embedding* – which takes your student to the originating website – is usually a safe practice, although linking to work known to be stolen can lead to "contributory copyright infringement" (Siegel, 2022). A "server rule" was created in a 2007 Ninth Circuit ruling wherein if an item is taken from someone else's server and put on your own, it is an infringement, but if it is embedded by using code that pulls it directly from the originator's server instead, it is permissible. However, in 2018 and again in 2021, New York district courts rejected this position. Part of the problem is the contentious concept of *fair use*, especially in social media (Whitney, 2021).

Licensing may be "rights managed" (every instance incurs a fee), "royalty-free" (one fee covers any number of instances), or free for commercial or non-commercial use. Some are under Creative Commons licenses which set instructions for sharing. Yet others are in Public Domain, requiring no attribution. Music might be in Public Domain if the copyright has lapsed, typically 70 years after the death of the creator/copyright holder – or the creator has decided to offer it free to others (Olondriz, 2021). Importantly, copyright holders might well be performers protecting their recording of a work composed centuries ago. Olondriz (2021) affirms that most recorded music is indeed protected. The U.S. Digital Millennium Copyright Act (DMCA) of 1998 provides a process for demanding illicitly shared online materials to be removed (Wolff & Gross, 2017). In short, the recommendations are:

- Assume all work by others is protected under copyright unless specified otherwise.
- Read licenses for *all* items you have not created yourself and follow directives therein.
- Link to items if they are not your own. Ensure these materials are legitimately shared at its source.
- Embed only those materials you have created and therefore possess true ownership.
- Ensure institutional rules are followed.

File Creation

There is no specific length recommended for either audio or video. Because attention spans tend to be short, be succinct. Kowton (2019) suggests the first five seconds are the most important in capturing the viewer's attention.

Audio File Types. Mp3, ogg, wma, aiff, wav, flac, and others are possible (Edney, 2022). The newer m4a purportedly provides better sound quality and is created without Digital Rights Management restrictions (Clark, 2022). While the compression of mp3s is "lossy" (some data is lost when the file is made into a manageable size), it is supported by all major browsers and most devices at this time (Edney, 2022), making that format currently the most reliable choice.

Audio File Recommendations.

- Preparation: Write your transcript first. It can be edited later if you make changes while recording, but helps to avoid filler sounds such as "um" (Knott, 2020).
- Microphone: Use a microphone on a stand to minimize noise from movement. Keep it close but not directly in front of the mouth to avoid plosive Ps and sibilant Ss ("Microphone Tips," n.d.). Consider a "pop filter" (Hammer, 2021), and a cardioid microphone (Messitte, 2021) if you regularly record your voice.
- Location: Record with windows and doors closed for avoiding extraneous noise; make sure the room has some absorbing materials such as carpeting and blankets to limit reverberation (Hammer, 2021).
- Vocalization: Speak clearly and with inflection, watch the volume and pacing, and make sure all words are pronounced correctly (Knott, 2020). Work for a consistent breath flow to keep the voice calm.

Video File types. Among the many video file types possible are mp4, mov, avi, and WebM. The latter might not be supported by Macs. For now, mp4 is recommended for compatibility and reliability across platforms (Rawat, 2022).

Video with People as the Main Visual Subject.

- Microphone: See Audio Factors above.
- Lighting: Avoid sitting in front of a window, as it may show reflections. Castillo et al. (2021) says to use two light sources set at 45-degree angles down towards the speaker to limit facial shadows.
- Background: Sit a few feet in front of a solid-color sheet, wall, or drapery for simplicity or ensure the view is free of distractions and considered a "professional" representation (Bedrina, n.d.). It is not necessary to place your subject in the center of the screen. Use the "rule of thirds" wherein a grid of 3x3 is imagined, and align main elements along these lines (Shewan, 2021).
- Camera placement: Set it in a static position. Changing placement during recording (such as "panning") can be a distraction and could result in a shaky video view (Bedrina, n.d.).
- Other: Recording oneself allows for verbal and non-verbal communication and is considered "rich media" (Grewal et al., 2021). Attention to one of these cues – such as a person's physical mannerisms, their vocal inflections, or even their clothing and hair style – can distract from the true message (Grewal et al., 2021).

Video Narrating a PowerPoint presentation. This focuses on content instead of the speaker. Simply reading slides is not recommended, as the viewer reads faster than a speaker. For the sake of accessibility, providing a handout of the transcript or Notes pages would be appropriate (Parkinson, 2018). Some guidelines:

- Use only relevant imagery, place objects in an understandable grid, use a template for consistency, and avoid overly busy screens (Parkinson, 2018).
- Use no more than two fonts, avoid color dependency (where color must be correctly identified to deliver a message), and ensure high contrast of text to its background (Grant, 2018).

Video Showing a Process via Screencast (also called video screen capture). Displaying your computer screen or an open window in an application to demonstrate tasks can be accomplished in Zoom or any number of other tools. It is imperative to demonstrate and explain actions slowly enough for viewers to grasp.

Other Video Considerations. If using a white board, consider whether you wish to write on the board while you explain the concepts or if wording/graphics should already be on the board so the focus is solely on the explanation (Mayer 2021). If your software allows you to alter screen resolution, it may be best to record, edit, and plan for presentation on the page (output) in the same resolution, rather than trying to edit after recording (Ozer, 2021).

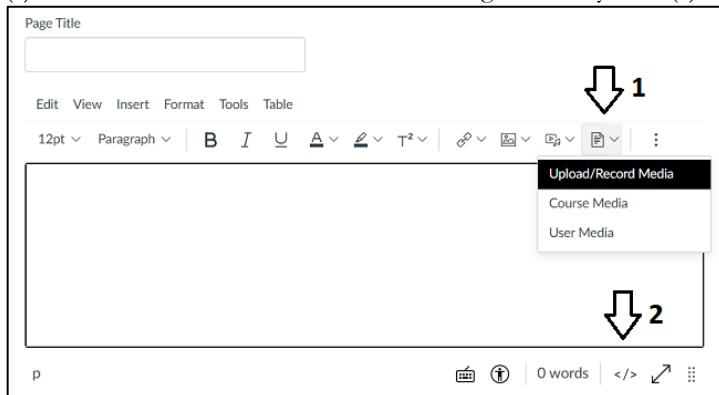
Final Delivery Methods

Instructional designers are trained to know how to insert modules in the online classroom, but the instructor can also learn basic coding. Learning Management Systems generally offer "What You See Is What You Get" input

(where coding knowledge is not needed) but most will also allow change to a coding view, with the opportunity to either link or embed multimedia properly. The coding environment can typically be found by looking for the characters < > or </>. The system itself may also have simple tools to upload or link files.

Figure 1. Canvas Page input options

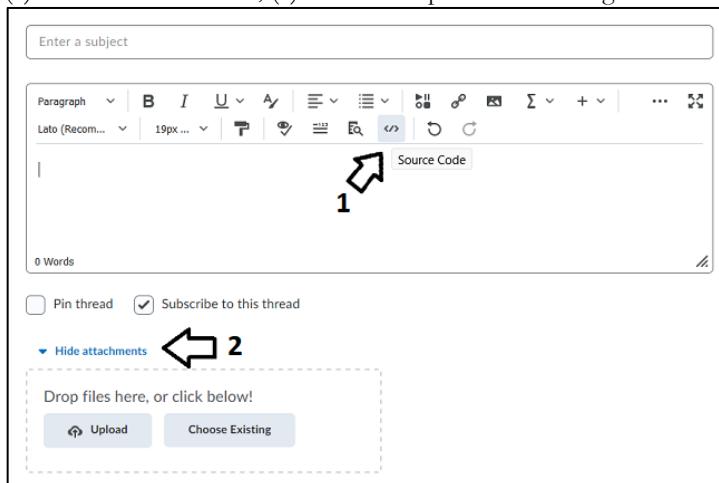
(1) a button to insert and even record media right in the system; (2) a link that changes the view to HTML coding.



Screenshot from Instructure (n.d.).

Figure 2. BrightSpace Discussion post input options

(1) a link to HTML view; (2) a link that opens for attaching the file instead as another delivery option.



Screenshot from D2L (n.d.).

Linking Code

Linking to audio or video is possible if the audio or video file is hosted on the web already, such as at YouTube, Vimeo, or a webhost such as Wix.com. It also works if the person posting has their own website or the institution provides hosting services. The HTML code needed is shown below, and the result would be a text link. In the second example, *target* is added to open a new browser tab, keeping the classroom window/tab open for easy return.

```
<a href="FullWebAddress">Text to show on page</a>
<a href="FullWebAddress" target="_blank">Text to show on page</a>
```

Embedding Code

This option places the multimedia inside the classroom so students are not sent to other parts of the internet to watch or listen. To embed audio, use the code shown below (assuming the file is an mp3), and include the alternative text for accessibility as explained previously. Figure 3 shows how this looks in the browser and includes full timing.

```
<audio controls>
    <source src="FullFileAddress" type="audio/mp3">
        Alternative descriptive text
    </audio>
```

Figure 3.**Embedded audio.**

(1) start and stop; (2) move forward or backward to relisten to skip parts of the recording; (3) set relative volume.

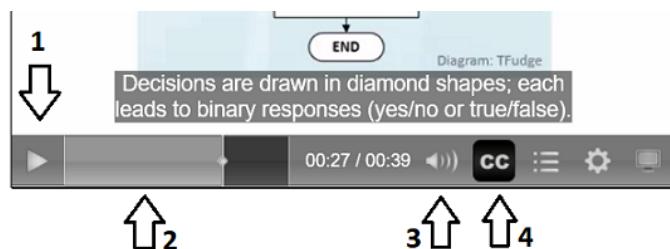


Embedding video requires similar coding. Below, the file being coded is an mp4 video, and width and height are coded to control the exact size in pixels – which may need to be tweaked to match the aspect ratio of the original. It is possible to code the width only, which would avoid problems with miscalculating the height. Figure 4 shows how this appears in the browser and again shows full module timing.

```
<video width="500" height="400" controls>
    <source src="FullFileAddress" type="video/mp4">
        Alternative descriptive text
</video>
```

Figure 4.**Embedded video**

(1) start and stop; (2) movement forward or back; (3) volume; (4) Closed Captioning.



In both audio and video beginning tags, the word "autoplay" could be included, but this is highly discouraged and some browsers will not honor it. Giving control to the user is always preferred. Some systems and browsers allow for deprecated (old) coding practices such as the use of the <embed> tag, however, this should be discouraged. As browsers evolve, deprecated code may cease to render (Guevara, 2021). The embed tag also may require use of a plug-in which is no longer part of browser construction.

Conclusion

The coronavirus pandemic dramatically changed the dynamics and delivery of work and school. Even as the virus hopefully wanes, many businesses are now promoting work from home, and schools previously not espousing online learning found it was indeed viable and valuable. One of the first changes in March 2020 was to quickly establish virtual classroom sessions via Zoom or other tools but there was a dearth of training available. Cabaleiro-Cerviño and Vera (2020) also mention institutional planning failures including costs of development and implementation in this crisis. Fortunately, today there are tools readily available – many of which are free – and there is now a better understanding of how to deliver quality content using a variety of methods. Both audio and video modules can be planned, created, and delivered in the online classroom and still meet diverse student needs.

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Appendix

The relative ease of use for each program below is the author's subjective assessment using a scale of 1-5 (easy to difficult) and may not reflect the reader's view. As with the use of any application, care should be taken when downloading any software, and further investigation is recommended.

Audio Creation Tools

- Audacity (free download) - <https://www.audacityteam.org>** Ease of use: 2.5
- Operating systems: Windows, Mac, Linux. Related software: requires free download of Lame as well.
 - File types: mp3, wav, ogg, aiff, flac, others. Save projects as aup for later editing.
 - File management: download and upload, but no online hosting.
 - Editing: Trim, scrub, fade, multiple tracks, volume control, time shift, combine files, noise removal, more.
 - Online manual: <https://manual.audacityteam.org>

- WavePad by NCH (free download) - <https://www.nch.com.au/wavepad>** Ease of use: 3
- Option: One-time payment for more robust features, commercial use.
 - Operating system: Windows
 - File types: mp3, m4a, wav, ogg, aiff, flac, others. Save projects as wpp for later editing.
 - File management: download and upload even from CDs. No online hosting but easy email and upload to YouTube and cloud providers.
 - Editing: Trim, split, join, multiple tracks, effects, create ringtones, text-to-speech voice, more
 - Online tutorials: <https://www.nch.com.au/wavepad/tutorial.html>

- PowerPoint (download or Office 365)** Ease of use: 2
- File types: m4a upon downloading (can also listen inside a PPT presentation)
 - File management: download and upload, but no online hosting.
 - Editing: Fade/trim, volume, loop, rewind
 - Tutorial: Search at <https://support.microsoft.com>

Table 1.
Free Browser-Based Recording Tools (mp3 output, allow file downloads) Ease of use: 1

	Vocaroo	Online Voice Recorder	Rev Recorder
URL	https://vocaroo.com	https://online-voice-recorder.com	https://www.rev.com/onlinevoiceRecorder
File upload	Yes	No	No
Online hosting	Yes. Links, embedding, and QR codes for hosted files	No	No
Features	No editing but can set some parameters before recording	Minor editing includes trim, volume, pitch	Pause while recording, minor cropping
Other information	Help available at: https://vocaroo.com/faq	Home page has navigation to tools and information	Related phone apps available. Requires signup after a number of tiles are made. Written transcripts at cost.

Other Audio Tools

- Windows 10: **Voice Recorder** and Windows 11: **Sound Recorder**
- Mac OS: **QuickTime** and **Voice Memos**.
- Various phone apps for iPhones and Android devices.

Video Creation Tools

Zoom (free, browser-based) - https://zoom.us	Ease of use: 2.5
<ul style="list-style-type: none"> • Option: Paid subscription includes ability to set parameters before recording and to save to the cloud. • File management: Audio saves as part of the video but also is saved separately. • Screen views: Web cam, screen share (PowerPoint, browser, desktop, etc.). No chat pod in recordings. • Captions: can be set for automatic transcripts. • Tutorial: https://support.zoom.us/hc/en-us/articles/201362473-Enabling-and-starting-local-recordings • Similar programs: Microsoft Teams, Google Meet 	

PowerPoint (download or Office 365)	Ease of use: 2
<ul style="list-style-type: none"> • File types: mp4, Windows media file, PowerPoint Show • Screen views: Full screen PowerPoint, with drawing capability. • Tutorial: search https://support.microsoft.com 	

Table 2.		Ease of use: varies
Video Recording Tools for Download (all allow file downloading)		

	TechSmith Capture	NCH VideoPad	OBS Studio
URL	https://www.techsmith.com/jing-tool.html	https://www.nchsoftware.com/software/video.html	https://obsproject.com
Cost	Free	Trial	Free
OS	Windows, Mac	Windows, Mac	Windows, Mac, Linux
File upload	No	Yes	Yes
Project files	mp4	Save as mp4; project files as vpi allow for later editing	mkv, but mp4 is possible
Other information	Sign-in required. Control screen size. Download to computer or save to Screencast; URL for sharing, embed code given.	Free trial has limits. Other versions for one-time costs, the latter offering unlimited tracks and plugins. Monthly subscription another option.	Sign-in required. Saves to the user's computer. Allows for live streaming. Includes audio mixer, scaling, more; currently also has an experimental caption feature.
Help	Search at https://support.techsmith.com	https://www.nchsoftware.com/videopad/tutorial.html	https://obsproject.com/wiki/OBS-Studio-Quickstart , plus a forum and other guides
Ease of use	1.5	4	4.5

Table 3.		Ease of use: varies
Free Browser-Based Video Recording Tools		

	Canva	Animoto
URL	https://www.canva.com	https://animoto.com
File download	Yes	No; requires paid version for downloading
File upload	Yes (necessary to use your own audio)	Yes
Project files	mp4 - Saved in "Your Projects" folder	mp4
Other information	Online hosting: URLs to share. Templates for styling, add text and elements (shapes). Timings, much more since videos are built from scratch	Direct share to social media; provides URL. "Voice-over" feature to add narration, templates, stock photos, music, other editing features. Paid version removes "Made with Animoto" watermark and offers more features.
Help	https://www.canva.com/designschool/tutorials	https://animoto.com/resources/tutorials/directory
Ease of use	3.5	3

Other Video Tools

- Windows 10 and 11: **Video Editor**.
- Mac: **iMovie**
- Built-in camera video potential in iPhones and Android devices.