Creating and Using Videos (or Video Based Learning Objects) to Enhance Your Safety Training

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Introduction

Humans are a visual species. We assimilate information rapidly through visual media. Images flashed before us in music videos for as little as a quarter of a second are readily absorbed and understood. In as little as 15 seconds, advertisers, using visual media effectively, can influence behavior and purchasing decisions. Images on news broadcasts, documentaries and films are broadcasted to influence our opinions and convey ideas. Although the power of images to influence human opinions and behavior—and the speed with which visual media can communicate— have been understood for decades, the EH&S field has not leveraged the use of this media to the degree possible to maximize learning.

The limited adaptation of this powerful tool has been largely due to the high cost of producing visual media of an acceptable quality. But two simultaneous technological breakthroughs that occurred about a decade ago changed everything: (1) the introduction of inexpensive digital camcorders and now cameras capable of capturing high definition video images and storing them on solid media (flash drives) that can be easily transferred to computer hard drives; and (2) the availability of software programs installed on computer workstations and laptops that can easily manipulate these large video files and produce digital effects. All of this—a high definition digital camcorder or camera, computer editing workstations and associated software—is readily available today for a few hundred dollars to a few thousand dollars. This is less than the cost of most field monitoring equipment. Powerful, high definition, professional quality video can now be developed inexpensively by anyone, and this is changing the way we communicate ideas and train workers.

Background Information – Learning Objects
Learning objects, "chunks" of learning content that focus on a specific learning objective, are widely used in educational settings where different types of media – images, flash animations, simple simulations, video and audio recordings are available to educators from a database of media. Educators can select the objects that help them fulfill their learning objectives and incorporate them into educational materials or lectures. These learning objects can be reused many times, can be used in different instructional contexts, and by different educators. Learning objects have been referred to as the LEGO building blocks of educational content. The concept of sharable learning objects has not effectively transitioned to the environmental health and safety training domain where it could assist trainers convey difficult technical topics, provide a much more

effective visual medium than the standard PowerPoint default bullet list and, if properly designed, foster interaction between trainer and training participants.

Video based learning objects (objects) can be created to fit into existing training programs, fill gaps or replace lesser quality content. These objects are short – from ten seconds to approximately three minutes in length– and designed to demonstrate a key concept, illustrate how to apply a concept in an actual work environment, shape attitudes and/or assess learning. The objects are specifically designed to encourage interaction between training participants and trainer, and may be designed to fulfill the "visual evidence" component of the assertion-evidence approach to creating presentations. The objects can be individually selected by the trainer, allowing them to retain complete control over the content and the delivery of their training programs while taking advantage of the power of digital videography. Table 1 provides additional information on how video clips can be used with specific examples.

Clip Category	Description
Demonstrations/ Informational	These clips provide a visual demonstration of how to perform a task, operate a tool or piece of equipment, or are a visual representation of a key concept. They facilitate the transfer of concepts and information. Examples include the illustration of: • chemical hazards/properties (i.e., flammable, corrosive, reactive) • physical properties of chemicals (i.e., volatility, vapor pressure, vapor density, specific gravity) • the reaction of incompatible chemicals • the use of specific types of real time instruments for monitoring gases, vapors and aerosols (uses and limitations of gas chromatograph; portable IR; PIDs; FIDs) • the shielding of ionizing radiation – alpha, beta, gamma the inverse square law (exposure vs. distance) and use/limitations of a survey meter and ionization chamber • donning and doffing respirators and PPE • penetration of protective clothing by chemicals – chemical resistance
Attitude Shaping	These clips provide an understanding of the value and importance of doing the job correctly: • Broadcast footage describing incidents and accidents and consequences of same • Peer descriptions of lessons learned from injured workers or from near misses • Peer experts describing importance of key concept based on their experience (story telling) • Historical clips illustrating how tasks were conducted in the past or historical workplace conditions
Learning Assessment	These clips provide an entertaining way for participants to demonstrate acquired knowledge or skills • Clips that show poor work practices, poor application of knowledge or errors in judgment (participants engage in an exercise where they must identify issues)

Clip Category	Description
Case study – practice and applying content	• Clips shown in sequence that allow participants to interpret information presented, make decisions and review consequences of decisions • Clips reviewing facts surrounding incidents or accidents that ask participants to apply knowledge to arrive at likely cause/origin of event

Table 1. Description of Clip Categories with Examples

The components of video based learning objects and how this impacts their use

When designing video based learning objects it's important to remember that there are two basic components.   The first component is the concept or the specific information being conveyed. An example would be a short video clip illustrating the concept of flashpoint. The second component describes how the content applies to the learner's work environment, or provides context for the specific information. An example of this would be a clip that, in addition to illustrating the concept of flashpoint, illustrates the difference between the flashpoint of gasoline and diesel fuel and how this difference impacts the safe operation of heavy equipment. A video based learning object will always contain the first component but may contain more or less of the second component, the application of the concept to the work environment. If one is constructing learning objects with the intention of using them broadly (i.e., in many different training programs), then one must construct them so that they convey just the concept and provide little or no context. In these cases the trainer must describe how the concept being conveyed applies to the specific work environment.   This facilitates the interaction between the trainer and training participants. The more "context" designed into the video-based learning object, the fewer applications there will be for the clip.

The different designs for video based learning objects

Video-based learning objects may be simple, or single stand-alone clips, or compound objects, a series of clips that are shown one after the other and work together or complement each other. Questions are typically posed to training participants in between the video clips found in compound objects. Compound video-based learning objects are built to present case studies or test trainees knowledge/grasp of content recently presented in a training session. Figure 1 illustrates the different designs. Simple or stand-alone objects are often placed in PowerPoint using the assertion-evidence design approach. Compound objects may be placed in PowerPoint, one video per slide with questions in subsequent slides, or authored into flash objects and linked within PowerPoint using an authoring program such as Adobe Captivate. Both simple and compound video-based learning objects foster an interaction between the instructor and training participants and unlike most videos used in training, keep the presenter involved.

Why produce your own video-based training material

There are a number of good reasons for developing your own video-based training content. The first and probably the most important reason for most safety professions is the need for a product that is site and topic specific, that illustrates local policies and procedures and features the images and perhaps interviews or stories of local employees and management. A second reason is that short video-based learning objects, the kind that can be used in an assertive-evidence approach to PowerPoint design, are simply not commercially available. And finally, producing your own give you complete creative control over the content, allowing very innovative video-based learning objects, such as compound learning objects.

The Problem with Microsoft PowerPoint

Microsoft PowerPoint has become the de facto tool for worker training. The software is seductive because it affords quick and easy creation of presentations, but there are many criticizing it as more valuable to the trainer than the student. A particular focus of criticism is PowerPoint's default mode that drives designers to create endless bullet lists that produce questionable learning among students. Edward Tufte, one of the strongest critics has noted that "It's much easier to write a presentation if you're writing in bullet grunts." He challenges the use of PowerPoint based on the fact that the default styles of PowerPoint limit the amount of detail that can reasonably be presented and often obscure logical connections (or the lack thereof) among facts used to make an argument. Others point out that bullet points leave critical assumptions unstated and critical relationships unspecified. However, PowerPoint slides can be an extremely effective way to present visual aids such as video clips.

New research has suggested that a new presentation design for PowerPoint presentations called "assertion-evidence" (AE) is more effective. In this approach to presentation design a succinct sentence headline (the assertion) is written on the top of the slide and supportive visual evidence to meet the audience's need to understand the technical concepts being presented is provided below in place of bullet lists. This alternative design makes communication more efficient, memorable, and persuasive, and is much better suited to the presentation of technical training material than is the traditional bullet list. Short video clips or video based learning objects make ideal visual content for slides designed in this manner.

The authors have also created presentations that incorporate video clips that build on each other and are shown sequentially (compound objects), typically incorporating a question-answer session between clips. This allows the trainer to present case studies as well as test a training participant's knowledge of recently reviewed content in an interactive format. Trainers have found these compound objects to be very valuable training aids. Comments from trainers include: easily adaptable, encourages dialog and very useful resource.

Video Clip Development

Creating video clips for use in training involves four major steps:

1. Identifying the visual sequences (storyboard) and associated narrative (if any)
2. Shooting the video and gathering images and/or graphics (as outlined in visual sequences) and capturing narration (if used)
3. Editing the video
4. Rendering the clip into Windows Media Video (WMV) format for inclusion in PowerPoint (or other format for streaming purposes or inclusion in other presentation software)

For each clip one or more learning objectives is identified and the clip is then designed to fulfill the objective. This involves identifying the visual sequence (or the series of shots, still images and possibly graphics) that will make up the final clip and writing any narrative that will accompany the clip. This process is call storyboarding.

If narration will not be used in the clip, the visual sequence drives the organization of the clip. Usually the visual sequence will follow some operation, procedure or event so the shots will be ordered exactly how the action being captured occurred. A shot list is made from these steps.

If a narrative will be included with the visual component it should be written first. This is because the narrative will provide the structure or organization for the clip. Narration should be written in short simple sentences but be careful. A narrative may be well written, but when spoken some content may sound confusing or awkward. It is therefore best to read the narrative out loud when composing and editing it. A good narrative is easy to read aloud. You will find yourself constantly simplifying your narration.

Once the narrative is written, images (video, still images, graphics, etc.) are brainstormed that reinforce and illustrate what is said in the narrative. A good way to do this is to place your narration into one column of a table and in the adjacent column list the visual elements you plan to show while the narration is playing. The visual elements in a clip would be most often video sequences but may also include still images, illustrations, or graphics. It is critical that the visual element support the key concepts being conveyed in the narration by visually illustrating the points made.

When creating video clips, either with or without narration, we often don't show an entire event but rather the parts of the event that illustrate the key concepts we are trying to convey. In order to collapse time in a way that is acceptable to viewers (without creating jump cuts) we use shots taken from different perspectives – namely wide, medium, and close up shots. Wide shots incorporate the entire body or the location in which the action is taking place. This is the shot that is often shown first because it establishes the characters and their placement in the scene and allows you to cut to other shots like the medium shots and close ups for more detail. A medium shot typically incorporates a person's body from the waist up. This shot is often used when demonstrating a particular procedure. A close up shot is a shot that incorporates the body from the shoulders up or focuses in on a detail, such as what is being done with the hands. We can compress time in video by jumping from one type of shot to another. The easiest way to shoot a clip is to have the subject perform the action three times and shoot it from the three different perspectives – wide, medium and close up. This allows a lot of flexibility in the editing phase where one can select from several shots of the same action. When storyboarding, or making a shot list, the perspective of the shot should be noted.

Equipment used to capture video
Equipped with your shot list, generated from your storyboard or your video sequence, it's time to go out into the field and capture your high definition video images. Although this once required expensive video equipment it can now be done, at least for most type shots, with inexpensive video cameras and still cameras with video capabilities. Author Ouimet has shot video for several years with a $7,000 Sony EX1 high definition video camera, He has determined that his still cameras, a Canon T3i (~$1,000) and even his Cannon S100 (a small palm sized camera which cost ~$350), capture stunning video. All of the newer cameras capture their video in files stored on flash cards. These cards can be removed from the camera and inserted directly into a computer where the files are transferred to a hard drive for editing. The new cameras also work well in low light levels so no additional lighting is typically needed. In addition, their audio capabilities are sufficient to capture the sound in the environment for the type of video being described in this article. No matter what camera you use it is important that the shot be perfectly still; a shaky video will result in poor quality training materials. This means that a camera support, typically a tripod, must be used. The cameras described above are low weight so inexpensive tripods are sufficient.

<u>Capturing and editing narration</u>
A common error is to overlook the audio quality while focusing on the visual aspects of the presentation, but the quickest way to turn off the trainees is poor quality audio. If learners can't hear or understand the narrative, the endeavor has failed.

There are two components to audio recording – the microphone and the digital recording device. In the last couple of years software has become available to convert computers, usually laptops, into digital recording devices. The technology was developed to facilitate the development of podcasts, but works astonishingly well for capturing the narration used in video. The software and a quality USB microphone can be purchased for about $100. You will want to avoid using an analog microphone that plugs into a PC's microphone jack as its quality is significantly less than a USB microphone.

Another approach to capturing audio narration is to use a portable digital audio recording device and microphone. High quality audio recording devices that can be connected to high quality microphones can be purchased for between $250 and $1000. These devices can be set to capture very high quality sound (48kHtz in stereo) in a variety of digital formats on solid media such as a compact flash. This allows the recorded audio to be easily transferred to a computer for editing. These recorders all support XLR microphones which are the industry standard. High quality XLR microphones can be purchased for $200 to $500 but this equipment is often available at substantial discounts second hand on sites such as eBay.   The old saying "you get what you pay for" applies well to microphones. A good microphone will significantly improve your audio.

A critical audio production element is to select a person with a good voice. At one end, you don't want a monotone, meek voice to narrate, but at the other extreme you don't want someone screaming or shouting out the narrative. A person with a pleasant but authoritative voice is a good choice. Ideally, the narrator should be able to read the narrative error free, with minimal undesired sounds, such as frequent throat clearing or mouth smacking, and with proper pronunciation. The recording location also has to be carefully considered. Background noises need to be eliminated, and the room's reverberation level should be low as well.

No matter how good the narrator is some audio editing will be necessary. Audio editors allow you to cut and paste sections of the narrative or single words together in the narration very similar to the way a word processing program allows you to cut and paste text in a document. It is common to have a narrator read each paragraph of narration two or three times and then to construct a composite that contains the best sections of each of the readings. Audio editing also allows one to eliminate background noises and other extraneous noises. Professional software to edit audio can be purchased for approximately$400.

<u>Editing video</u>
Video editing is the process of editing video clips and sound recordings into finished video. During this process special effects, such as titles, pictures in pictures, transitions, etc., may be added. Most computers today have the speed and capacity to edit high-definition video. The two major retail computer operating systems include basic video editing software - Apple's iMovie and Microsoft's Windows Movie Maker. These free editors along with other free open source video editing programs such as VirtualDub, are capable of performing most of the editing functions required by beginning to intermediate video clip producers. More advanced commercial products such as Adobe Premiere, Final Cut Pro and Sony Vegas are required to create more advanced video

effects. But the clips discussed in this article do not require professional quality video editing software.

All video editors work in a similar way. Video clips are placed on a timeline in the order they are to be viewed and the ends are trimmed to show only the part of the clip desired. Separate audio files, such as a narration or sound effects, are also placed on the time line adjacent to the corresponding video. All of the files can be repositioned or reordered on the timeline until the editor is satisfied with the sequencing. Most editing software will play back the timeline in real time so the editor can see how the final video will look as its being produced. Transitions, such as dissolves, or fade to black, can be placed between clips and text can be layered over video. When video is finished it is output from the timeline in the video format and size desired by the editor. Figure 2 shows the computer interface of a common video editor – Adobe Premiere.

Formatting of clips for insertion into PowerPoint
Clips that will be inserted into Microsoft Power Point should be output as Windows media video (*.WMV). This digital video format is highly compressed (resulting in relatively small file size) and has a high degree of compatibility with PowerPoint (i.e., it never crashes).   The video and audio quality is high when compressed to 2MegaBytes per second for the WMV format (DVD quality video). Clips shot in high definition should be rendered into files with a size of 640 by 360, or 1280 by 720 pixels for higher quality. This will ensure a very high quality visual experience for training participants and will be easily playable on computers and laptops purchased in the last few years. Computers playing these clips in PowerPoint must have the free Microsoft Media Player (as well as Microsoft PowerPoint) loaded on their computer or laptop. All windows machines have Media Player preloaded.

Costs
The costs associated with producing your own video content fall into three categories: (1) the cost (if any) of the software to edit the media (images, video and audio); (2) the cost of the equipment to collect media (video and potentially audio); and (3) the time to produce the training. There is of course a learning curve associated with acquiring the skills necessary to develop video content and use the editing software packages. The one-time cost associated with the purchase of software ranges from free to approximately $1,000 depending on the software purchased and the institution you represent (academic institutions are given steep discounts). The one-time cost associated with equipment purchases (still/video cameras and audio recording equipment) ranges between $1000 and $5000 depending on the equipment purchased. If one has access to a computer microphone and digital cameras and uses freeware editing software, the initial cost would simply be your time. Once one becomes familiar with the training production process and editing software, it takes approximately one to two hours of development time per minute of video content produced.

References

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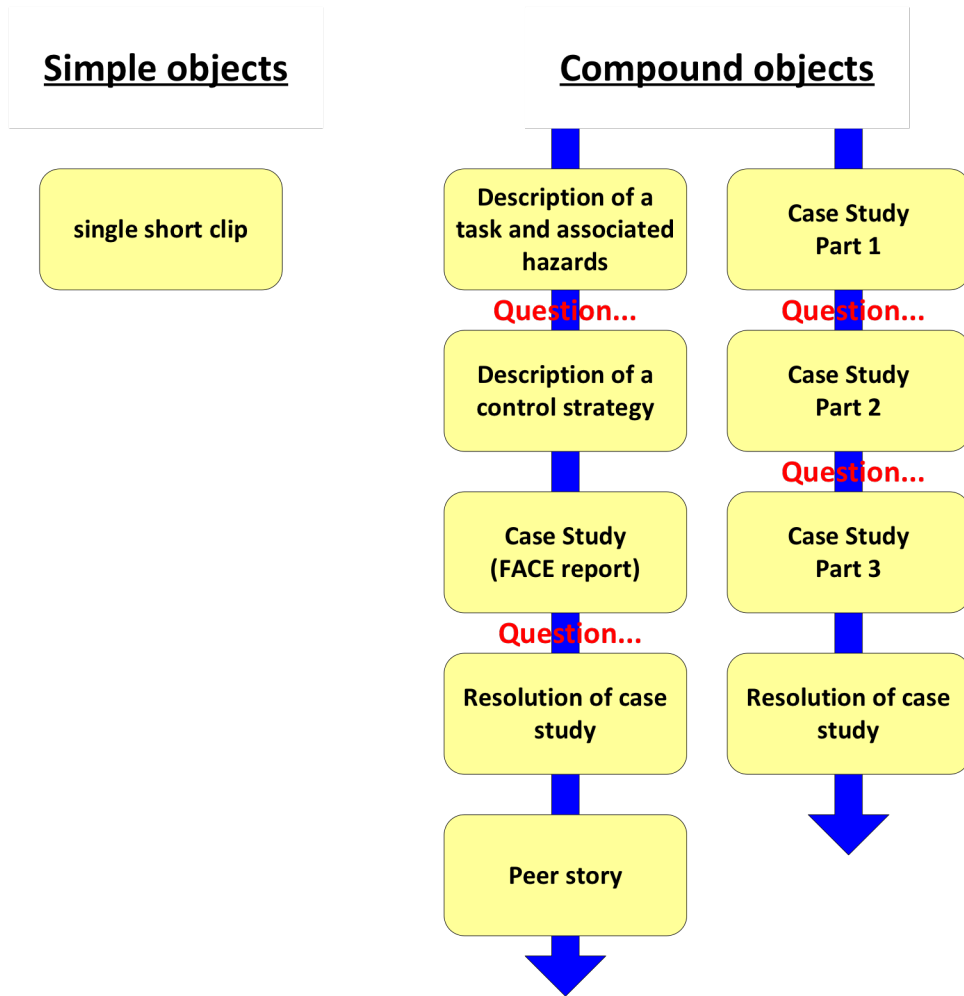Tufte, E. Beautiful Evidence. Cheshire, CT: Graphics Press LLC, 2006

Simple objects

single short clip

Compound objects

Description of a task and associated hazards

Question...

Description of a control strategy

Case Study (FACE report)

Question...

Resolution of case study

Peer story

Case Study Part 1

Question...

Case Study Part 2

Question...

Case Study Part 3

Resolution of case study

Figure 1. Differnet Designs for Video-Based Leaning Objects

Figure 2. Computer Interface of Common Video Editor (Adobe Premiere)