

TWELVE TIPS

Twelve tips for the effective use of videos in medical education

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Abstract

Videos can promote learning by either complementing classroom activities, or in self-paced online learning modules. Despite the wide availability of online videos in medicine, it can be a challenge for many educators to decide when videos should be used, how to best use videos, and whether to use existing videos or produce their own. We outline 12 tips based on a review of best practices in curriculum design, current research in multimedia learning and our experience in producing and using educational videos. The 12 tips review the advantages of using videos in medical education, present requirements for teachers and students, discuss how to integrate video into a teaching programme, and describe technical requirements when producing one's own videos. The 12 tips can help medical educators use videos more effectively to promote student engagement and learning.

Introduction

Video use in health professions education has risen exponentially in the past decade. For example, Stanford University School of Medicine has collaborated with the Khan Academy to develop and teach the core curriculum using short video clips in a flipped classroom model (Prober & Khan 2013). Medtube and UndergroundMed have been covering basic content and clinical competencies for introductory classes in recent years, and even YouTube videos have been widely used in health professions education. Medical schools who have been through curricular reform are increasingly adopting the clinical competency outcome framework (Cooke et al. 2006). Well-designed videos offer medical students the flexibility to review material at their own pace to address their individual learning needs under this framework. Many students already skip lectures and solely access educational materials online in digital format (Billings-Gagliardi & Mazor 2007; Kircher et al. 2010; Traphagan et al. 2010). Ideally, educational theories and best practices should guide the use of videos. Research on the effective use of technology in education shows that instructors need to be not only subject matter experts, but also have an empirical understanding of the technology to be used to deliver the content, as well as the teaching and learning pedagogy underpinning the use of a particular instructional format (Harris et al. 2009; Roblyer & Doering 2012). Videos can deliver traditional lectures to students before class, and transform didactic classroom teaching into more student-centered activities (King 1993; Froyd 2008). Though the use of video to promote learning has been extensively studied in lab settings (Mayer 2001), there remain gaps translating this research into medical education practice.

The question we address is: How to design videos in a way that is effective and efficient, and meets the needs of medical students and health professionals? The 12 tips are based on a review of research on video use in education, and our experience using video in clinical education to promote learning. The 12 tips are organized in a why/teacher/student/how structure to address: why to use videos, what should teachers do, what should students do, and how to use videos effectively in medical education. Table 1 summarizes the 12 tips.

Tip 1

The pedagogical advantages of using videos

Video use meets the needs of the current digital generation of students (Prensky 2001; Prober & Khan 2013). They often access online educational content, and when viewing video frequently fast-forward to or replay sections of the video as needed. Video presentations allow teaching to be scaled up to a large population of students without physical or geographical limitations. In a flipped classroom situation, students can review lectures in video format on their own, and spend class time on more student-centered activities such as interaction with peers and instructors (Baker 2011). By doing so, a teachers' role changes from that of lecturer to facilitator. Medical procedures can be demonstrated in a standardized manner to avoid inconsistencies between different live human demonstrators (Bellini & Akullian 2007; van Det et al. 2011). Videos also stimulate curiosity and engage students' attention by situating them in realistic clinical scenarios, and promoting authentic learning (Graham & Johnson 2011). Videos also

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Table 1. Twelve tips and implementation strategies for using videos in health professions education.

Tips	Strategies
Why 1. The pedagogical advantages of using videos	Videos can address the digital generation students' needs, be scaled up to a large student population, allow students' access anytime and anywhere, highlight key steps, demonstrate procedures in a standardized way, activate prior knowledge, stimulate curiosity, and promote student-centered activities.
Teacher 2. The requirements for teachers	Instructors should be knowledgeable about video technology and related education theories, and make an informed decision of when and how to use videos.
Student 3. Identify who the target students are	It is important to identify students' ability to use video, attitude and motivation for using videos in learning, preferences for live lectures or videos, and the heterogeneity of the cohort.
How 4. Orient students to the video content	Students should be oriented to the video content via activities before, during and after video viewing.
5. Use interactive elements to promote students' participation	Questions and quizzes should be embedded to promote students' participation.
6. Align videos with learning objectives and course outcomes	The video content should be closely aligned with learning objectives and outcomes.
7. Integrate PowerPoint slides, lecturer's image, on-screen captions, and transcript	Video should focus on the PowerPoint slides with the presenter occasionally appearing on screen. Audio should be accompanied with animation, with on-screen text highlighting key points, and a transcript available for reference.
8. Avoid cognitive overloading	Audio, video, on-screen text and accompanying transcript should be integrated to avoid cognitive overloading.
9. Engage students in video production	Students can be involved in video production. It is important to make sure that these videos have professional quality.
10. Limit video length	Videos should be limited to 10 to 15 minutes; longer videos should be divided into shorter segments, or have a hyperlinked index to facilitate navigation.
11. Identify credible professional quality videos	The videos should come from a credible source, be of high quality, and not violate copyright laws.
12. Consider technical requirements	Technical requirements such as shooting, editing, and hosting should be considered during planning as this may place constraints on the design and implementation of video use.

serve as knowledge anchors, around which students can explore, ask questions, and deepen involvement in a learning activity (CTGV 1990). In our experience, videos can cater to different levels of student experience in medical education. In undergraduate medical education, videos can be used to anchor basic science courses. At the graduate level, videos can deliver the core competencies as defined by the Accreditation Council for Graduate Medical Education (ACGME) for residents and fellows who often have limited and inflexible hours but a large amount of content to cover. In continuing medical education, asynchronous video use can help fit learning into clinicians' busy schedules.

Tip 2

The requirements for teachers

Successful video integration into the curriculum should be guided by knowledge of video technology, the subject matter to be covered, current theory of multimedia learning, and empirical best practice in using video (Shulman 1986; Mayer 2001; Mishra & Koehler 2006; Triola et al. 2012). Answers to the following questions should be sought at the outset when planning video use: What roles do videos play; for example, supplementing lectures or replacing traditional lectures with online modules? When and how to use videos? How does video use affect the learning process and outcomes? Educators must also have technical knowledge and skills. If they decide to produce their own videos, they should have a working knowledge of video production techniques (see Tip 12).

Tip 3

Identify who the target students are

Today's health professions education is often delivered to a large student cohort, with increasingly larger volumes of information to cover, under time constraints. How can we best design videos to facilitate student-centered learning? Prior research on technology in medical education highlights the importance of understanding the student cohort in designing educational content (Ruiz et al. 2006; Cook et al. 2008). It is important to get a thorough understanding of the target students' prior knowledge in the content area, skills in technology, as well as attitudes and motivation regarding the use of videos. If students have any preconceived ideas and biases about using videos, this should be addressed beforehand. Otherwise, negative attitudes toward video use may have a deleterious effect on their learning (Davis 1989; Reisslein et al. 2005). Addressing these questions helps to plan the video content, as well as guide decision making as to whether technical support should be provided for students.

Tip 4

Orient students to the video content

It is important to prepare students for what they are about to see in the video. Questions or discussions before viewing the video help to build the cognitive foundation for students to process the information (O'Neill & Wyness 2005). For example, in a face-to-face session, students should be

encouraged to discuss any parts of the video that they find difficult. Discussion helps to explain or clarify the problem. While watching the video, unplanned interruptions should be avoided. However, intermittent pauses to invite participation such as answering questions can promote deeper engagement. A balance between passive and active viewing with embedded questions or quizzes should be sought. Passive viewing of video is like information transmission to students, which is often not particularly effective in deepening understanding of difficult theoretical or abstract topics or promoting critical thinking (The Nielsen Company 2013). Interactive elements can facilitate learning of these topics.

Tip 5

Use interactive elements to promote students' participation

Most videos are presented in a linear format, which works well when discussions happen before and after viewing. Discussion helps to direct students' attention to the key teaching points of the video (CTGV 1990). By doing so, students are no longer passive listeners, but become active participants. However, without a physical environment, it is often difficult to maintain students' attention over a long period of time. Interactive elements such as embedded questions, quizzes and feedback help to maintain students' attention and promote students' participation, which is particularly useful for students studying independently online. Computer programs allow teachers to embed different formats of questions and tests within videos, such as YouTube, Adobe Presenter (<http://www.adobe.com/products/presenter.html>), Camtasia Studio (<http://www.techsmith.com/camtasia.html>), Adobe Captivate (<http://www.adobe.com/products/captivate.html>), Articulate Storyline (<https://en-uk.articulate.com/products/storyline-overview.php>), Lectora Inspire (<http://lectora.com/e-learning-software/>), Windows Movie Maker (<http://windows.microsoft.com/en-us/windows-live/movie-maker#t1=overview>), and Raptivity (<http://www.raptivity.com/>). They also make it possible for students to bookmark, annotate, search for certain points, fast-forward, playback, or pause the video, and view it as many times based on their own needs.

Tip 6

Align videos with learning objectives and course outcomes

Videos should be used for educational purposes. Videos only promote learning outcomes when instructors carefully set learning objectives, design learning activities, and align the use of video with the rest of the curriculum, similar to the use of any other learning technology or instructional method (Biggs 2007). The video content should focus on and illustrate key instructional points, with irrelevant information minimized to reduce a student's cognitive load (Sweller 1988; Mayer & Moreno 2003).

Tip 7

Integrate PowerPoint slides, lecturer's image, on-screen captions, and transcript

Video utilizes words and images to deliver information, with each being processed in different parts of brain (Mayer & Moreno 2003). Words can be presented as on-screen text or narrated audio. Images may be static such as PowerPoint slides or dynamic as animations or moving images. The multiple formats of information presentation serve students' preferences for either auditory, visual or verbal channels of learning (Mayer 2001).

- *PowerPoint slides.* PowerPoint slides are widely used during lectures to highlight key points, and their impact on learning has been validated (Blalock & Montgomery 2005; Nouri & Shahid 2005). Screen capture tools such as Camtasia (<http://www.techsmith.com/camtasia.html>) and Adobe Presenter (<http://www.adobe.com/products/presenter.html>) have been used widely to capture PowerPoint presentations and lectures.
- *Presence of lecturers.* There is no agreement regarding whether the instructor should be seen in educational video (Prober & Khan 2013). Based on our experience and review of videos by Khan Academy (<https://www.khanacademy.org/>), the common practice is that the lecturer appears at the beginning of the video. We speculate that seeing the lecturer's face helps to reduce the distance between students and the lecturer, and to situate students in a simulated classroom environment. To break the monotony of lecture, it is helpful to show the lecturer's face a few times. However, if the lecturer's face is displayed during the whole lecture, it can distract students from focusing on the presentation. In addition, the presenter should strive to maintain a professional persona.
- *On-screen text.* The use of text in video varies, a topic widely studied in the area of multimedia learning (Mayer 2001; Kalyuga et al. 2004). Based on a review of these studies and our experience using educational videos, we recommend the following guidelines. If the video demonstrates a procedure, for example, how to perform intubation, captions are useful to highlight the key steps. If the video narrates, for example, showing an inter-professional clinical scenario, captions are not necessary, however key commentary points should be presented at the end of the video. If the video is a record of a lecture, the transcript of the lecture or lecture notes should be made available online.

Tip 8

Avoid cognitive overloading

Text and images in video are processed separately in verbal and visual channels in our brain (Sweller 1988; Mayer 2001). However, each channel can only process a certain amount of information because of our limited working memory capacity (Miller 1956; Sweller 1988, 1999; Mayer 2001). When the information presented exceeds our cognitive capacity, this

results in cognitive overload, which has been shown to have a detrimental impact on learning (Mayer & Moreno 2003). To avoid cognitive overloading, concurrent activities in both channels should be integrated (Clark 2007; van Merriënboer 1997). The structure of the video should facilitate students' ability to organize content into a coherent cognitive structure, to integrate it with relevant prior knowledge, and to apply the information in new situations to solve problems (Elman et al. 1997; Quartz & Sejnowski 1997).

Tip 9

Engage students in the video production

Engaging students in video production is a student-centered activity that enhances content learning and improves student digital literacy (O'Neill & Wyness 2005). Students can be involved in selecting the content of the video and the most effective way to deliver the content. This approach is called learning by teaching, which has been used widely in professional education (Moore 1973). By doing this, students are put in the driver's seat, taking on the teacher's role during learning. In medical education, Kaufman (2003) advocates that "the learner should be an active contributor to the educational process" (p. 215). Advances in technology make it possible for students to produce instructional videos. For example, students can also use the camera to capture their practice for reflection or to teach junior students. They can also help to capture lecture videos by serving as AV technicians.

Tip 10

Limit video duration

In both live lectures and online learning, it is important to maintain students' attention and engagement. According to the *Nielson Social Media Report* of 2011, the millennial generation tends to use multiple devices such as smart phones to view videos (The Nielsen Company 2011). The smart phone platform makes attention to video length especially important. Longer videos demand greater effort to sustain focused attention. The longer the video, the less likely a student will watch it completely. Prober and Khan (2013) suggested that "Ten-minute videos have the advantages of being sensitive to the typical peak learning period for adults and are easily archived and searchable" (p. 1409). A longer video should be divided into shorter segments with interactive elements in-between, or include section titles so that students can easily find the segments that they need to replay.

Tip 11

Identify credible professional quality videos

With the Open Educational Resource (OER) movement, there are many high-quality videos freely available online. For example, the Emory University Mini Medical School offers a series of courses offered by Emory School of Medicine's top faculty members, which are freely available via iTunes. Educators are often faced with a wide and potentially

bewildering choice: Which ones are they going to select? Quality issues have been discussed widely for the OER movement (Hylén 2006; Atkins et al. 2007). Review of existing work on this topic suggests the following guidelines. First, the video should complement your instructional objectives. Second, the video should come from credible sources. To evaluate this you should ask: Is the author an authority on this topic? What are the author's credentials related to this topic? In which institution does he or she work? Does the author have peer reviewed publications on this topic? Is the information current and accurate? Third, the videos should have professional quality. Credible sources do not necessarily correlate with high quality videos. Professional quality videos contain high quality images, audio, and text. The video should be easy to access. Fourth, using these videos should not violate potential copyright issues. You should find out your institutional policies regarding use of online videos.

Tip 12

Pay attention to technical requirements when producing your own video

Advances in video technology make it possible to produce your own video even with a basic home use video camera or a smartphone. This is often a rewarding, though time consuming experience. It is important to make sure that the captured video has good sound and visual quality and does not have irrelevant background noises, which can easily distract the audience.

One challenge is to find a balance between the cost of video production, video quality, and time commitment for production. Technical requirements should be considered during planning as they place constraints on your video production and implementation decisions.

- *Shooting.* Advanced video technology does not necessarily make it easier to produce a professional quality video. Do you have the skills and equipment to shoot the video? Will you hire a professional videographer? What is your budget and the timeframe involved?
- *Scripting.* A script should be written with two columns, one representing the narration and the other indicating the video shots. A storyboard uses pictures to represent the shots. The script should indicate the framing and camera movements for each shot.
- *Location.* A sound-proof location is generally required to film the video. It is often better to film in a lecturer's office than classroom or lecture hall. The background should be kept minimalistic so as not to distract the audience.
- *Editing.* Do you have the skills and software to edit the video footage? What are the costs and timeframe involved? A few video editing programs to consider are: Jing (<http://www.techsmith.com/jing.html>), JayCuy (<http://jaycut.com/>), Tellagami (<https://telligami.com/>), Plotagon (<https://plotagon.com/>), and GoAnimate (<http://goanimate.com/>).
- *Format.* Will the video be compressed for online viewing? PCs and Macs have different video and software

compatibility requirements, so it is important that the video plays on any type of computer.

- *Hosting.* Cloud-hosted and self-hosted are two hosting options. For cloud hosting, there are free platforms like YouTube or fee-based ones such as Amazon cloud video hosting. Using free hosting platforms like YouTube can raise ethical issues because the video content is available to anyone with Internet access. This is an issue when the video is related to patient care. However, YouTube does give you the option to control access to your own channels. Many institutions use a password-protected online platform to host videos. For self hosting, you do have more control over the hosted content. However, institutional platforms normally do not offer unlimited server space. Compressed videos should be used if this is the case.
- *Peer review.* Get another subject matter expert to review your video before publishing online.

Conclusion

Best practices in curriculum design and use of educational technology, as well as an understanding of multimedia learning principles should guide video use in medical education. Educators can choose to use existing videos that meet their teaching objectives, or produce their own videos. The latter option requires sufficient technical skill and often, professional guidance. Strategies such as interactive elements in video should be used to promote active student participation. A balance in the use of multimedia elements should be sought to avoid cognitive overloading.

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