

Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content

Brame, C. (2016). Published in *CBE-Life Sciences Education*, 15:es6, 1-6.

Summary/Excerpts Prepared by Dr. Cathy A. Pohan, CETL

Educational videos are often utilized as the main vehicle for content-delivery in flipped, blended and online courses. Even in traditional courses, multimedia often supplements lectures. Brume's (2016) review of literature provides a wealth of scientific evidence demonstrating that video can be a highly effective educational tool. However, not all videos are created equal.

"Guo and colleagues (2014) have shown that students often disregard large segments of educational videos, while MacHardy and Pardos (2015) demonstrate that some videos contribute little to student performance" (p. 1).

Three Key Elements to Guide the Development and Use of video

CONSIDER COGNITIVE LOAD (CL)

CL refers to the memory demands during the learning process. CL has three components:

- intrinsic load is *inherent to the subject under study* (i.e., essential understandings of the discipline); determined in part by the degrees of connectivity within the subject. In biology, for example, learning the names of the stages of mitosis would have a lower intrinsic load than understanding the process of cell cycle control.
- germane load is the *level of cognitive activity* necessary to reach the desired outcome (for example, analyze, synthesize, evaluate, apply)... incorporating these ideas into a schema of richly connected ideas.
- extraneous load refers to the *cognitive effort that does not help the learner toward the desired learning outcome*, which is often the result of poorly designed assignments or instruction (e.g., confusing or unclear instructions; extra information) but may also be load that results from stereotype threat or imposter syndrome.

Instructors will want to minimize extraneous load and should consider the intrinsic cognitive load of the subject when constructing learning experiences, carefully structuring them when the material has high intrinsic load (p. 2).

Working memory relies on two channels for information acquisition and processing (sometimes referred to as dual-code processing): A visual/pictorial channel and an auditory/verbal-processing channel. Use of both channels can facilitate the integration of new information into existing cognitive structures (or schemas).

Based on these theories, **four effective instructional practices are recommended** (Table 1):

1. **Signaling** – highlighting important information/essential understandings
2. **Segmenting** - chunking or interleaving information
3. **Weeding** – eliminating extraneous information
4. **Matching Modality to Content** -use both visual and auditory channels to convey new information

STUDENT ENGAGEMENT w/ VIDEOS

Guo and colleagues (2014) analyzed 6.9 million video-watching sessions within four edX MOOCs and concluded that

The median engagement time for videos less than 6 minutes long was 100%. As videos lengthened, however, student engagement dropped.

- The median engagement time with 9 to 12-minute videos was 50% and
- the median engagement time with 12 to 40-minute videos was ~20%
- Making videos longer than 6-9 minutes is therefore likely to waste effort.

Guidelines for Maximizing Student Attention to Educational Videos

- Most important guideline is to *keep it short*.
- *Use a conversational style* (personalization. Student engagement was dependent on the narrator's rate of speech, with student engagement increasing as speaking rate increased (Guo, et al., 2014).
- *Create or package educational videos in a way that conveys that the material is for these students in this class*. It is important to consider whether the videos were created for the type of environment in which they will be used. (For example, a face-to-face classroom session that is videotaped and presented within an online class may feel less engaging than a video that is created with an online environment as the initial target.)

ACTIVE LEARNING PEDAGOGY

There is abundant evidence that active learning provides clear advantages over passive encounters with course material through lecture. Learning activities moved online require some level of *self-regulation* on the part of the student (i.e., monitoring their own learning; identifying difficulties with the material, making judgments, building and interrogating mental models).

Novices within a field often have difficulty accurately judging their own understanding, often overestimating their learning (p. 4)

Incorporating prompts for students to engage in the type of cognitive activity necessary to process information (i.e., active learning) can help them build and test mental models, explicitly converting video watching from a passive to an active-learning event.

Suggested Instructional Strategies

1. **Package Video with Interactive Questions:** Studies reveal that students perform significantly better on subsequent tests of the material and report less mind wandering when they were asked to answer questions interpolated between ~ 5 min video lectures than students who did unrelated arithmetic problems between videos (Szpunar, et al., 2013). In addition, note-taking increased, students reported the learning experience was less ‘mentally taxing,’ and they were less anxious about the final exam.
Embedding questions directly into video and giving specific feedback on student responses has similar benefits to interpolated questions in increasing student performance on subsequent assessments (Vural, 2013) and has the additional benefit of making the video interactive.
2. **Use Interactive Features that Give Students Control:** Students who were able to control movement through the video, selecting important sections to review and moving backward when desired, demonstrated better achievement of learning outcomes and greater satisfaction (Zhang, et al., 2006).
3. **Use Guiding Questions:** When compared to a group of students that were asked to watch a video with no special instructions, students that were provided with eight guiding questions to consider while watching scored significantly higher on a later test (Lawson, et al., 2006). Guiding questions serve as an advance organizer, focusing attention to important elements, and increasing the germane load of the task. This strategy is often used to increase student learning from assigned readings (p. 5).
4. **Make Video Part of a Larger Homework Assignment:** MacHardy and Pardos (2015) have developed a model relating educational video characteristics to students’ performance on subsequent assessments. They observed that videos that offered the greatest benefits to students were highly relevant to associated exercises (i.e., assignments).
5. Zubair developed videos on that were embedded in a larger homework assignment in Paul Laibinis’s chemical engineering class and found that students valued the videos and that the videos improved students’ understanding of difficult concepts when compared with a semester when the videos were not used in conjunction with the homework (Zubair and Laibinis, 2015).
6. The important thing to keep in mind is that watching a video can be a passive experience, much as reading can be. To make the most of our educational videos, we need to help students do the processing and self-evaluation that will lead to the learning we want to see (p. 5).

Element to Consider	Recommendation	Rationale	Examples
Cognitive Load	Use signaling to highlight important information. Use segmenting to chunk information. Use weeding to eliminate extraneous information. Match modality by using auditory and visual channels to convey complementary information.	Can reduce extraneous load. Can enhance germane load. Manages intrinsic load. Can enhance germane load. Reduces extraneous load.	- Key words on screen highlighting important elements. - Changes in color or contrast to emphasize organization of information. - Changes in color or contrast to emphasize relationships within information. - Brief out-of-video text explaining purpose and context for video (e.g., learning objective for video). - Short videos (6 minutes or less). - Chapters or click-forward questions within videos. - Eliminating music. - Eliminating complex backgrounds. - Khan Academy–style tutorial videos that illustrate and explain phenomena. - Narrated animations.
Student Engagement	Keep each video brief. Use conversational language. Speak relatively quickly and with enthusiasm. Create and/or package videos to emphasize relevance to the course in which they are used.	- Increases percentage of each video that students watch; may increase total watch time. May decrease mind wandering. - Creates a sense of social partnership between student and instructor, prompting the student to try harder to make sense of the lesson. - Increases percentage of each video that students watch. - May increase sense of social partnership between student and instructor. - Increases percentage of each video that students watch. May increase germane cognitive load by helping students recognize connections.	- Multiple videos for a lesson, each ≤ 6 minutes. - Placing the student in the lesson by use of “your” rather than “the” during explanations. - Use of “I” to indicate the narrator’s perspective. - Speaking rates in the 185–254 words per minute range. - Expressions of instructor excitement, such as “I love the next part; the way the feed-forward mechanism works is so elegant,” or “Consider how the cell solves this tricky problem of needing to regulate three genes in sequence; it’s really cool.” - Videos created for the class in which they are going to be used, with instructor narration explaining links to preceding material. - Explanatory text to situate video in course.

Element to Consider	Recommendation	Rationale	Examples
Active Learning	• Packaging video with interactive questions. • Use interactive features that give students control. • Use guiding questions. • Make video part of a larger homework assignment.	• May increase germane cognitive load, improve memory via the testing effect, and improve student self-assessment and motivation. • Increases student ownership • May reduce extraneous cognitive load.	• Integrate questions into videos with Kaltura. • Follow short videos with interactive questions within an LMS or within Google Forms. • Package videos with a series of questions or problems that ask students to apply the concepts from the videos.

Patton (2016). Table 1: Practices to Maximize Student Learning from Ed. Videos (p. 3)