



## Attending to Cognitive Capacity

The availability of screen recording tools like, Kaltura Capture, a tool available to the entire Minnesota State community has made it extremely easy for anyone to record their screen as they narrate. As such, videos have become a popular way to deliver instruction to students. Media outlets [[1](#), [2](#), [3](#), [4](#), [5](#)] that cover education are filled with stories that suggest that practices like flipped classrooms and massive open online courses (MOOCs) along with services like Khan Academy, LinkedIn Learning, and YouTube create the impression that these prepared instructional videos are somehow inherently better for student learning.

Don't be misled to believe that instruction delivered via video is inherently *better* than instruction delivered in person. It is not the media (video) used to deliver instruction that influences student learning, it is how you have designed your instruction within these videos that can influence student learning.

As many of our colleagues are considering creating instructional videos to support learning from a distance, this month's Pedagogy and Practice provides guidance for creating videos that attend to the limited cognitive capacity we all have when trying to learn something.

We've spared you from reading entire textbooks on how people learn, instructional design, and multimedia learning (although if you'd like some good resources you can find them in our links). Instead, we have summarized some principles [shared by cognitive psychologist, Richard Mayer](#), that can guide you as you create videos to deliver instruction to your students.

### Defining Learning and Instruction

First, let's get on the same page. What is learning and what is instruction. Information is everywhere. Having access to this information does not mean that students will learn. As instructors, we can't do the learning for students, but we can create an environment through our instruction to assist. Let's define these terms.

#### *Learning*

Learning is a change in knowledge attributable to experience.

1. Is a change
2. In what the learner knows (inferred from a change in behavior)
3. Caused by the learner's experience

## Instruction

Instruction is the instructor's manipulation of the learner's environment in order to foster learning. Multimedia instruction is instruction that uses words and pictures.

1. Manipulating what the learner experiences
2. With the intention to cause learning

## Metaphors for Learning

Let's focus more on learning. Research and our understanding of learning has evolved. Consider these different metaphors that have been used to conceptualize learning. At different times, you probably have adhered to one or more of these metaphors. There are different times and reasons when we would pursue each of these metaphors for learning. In this module, we are going to focus on Knowledge Construction. You'll be asked to create instructional videos that encourage students to construction knowledge.

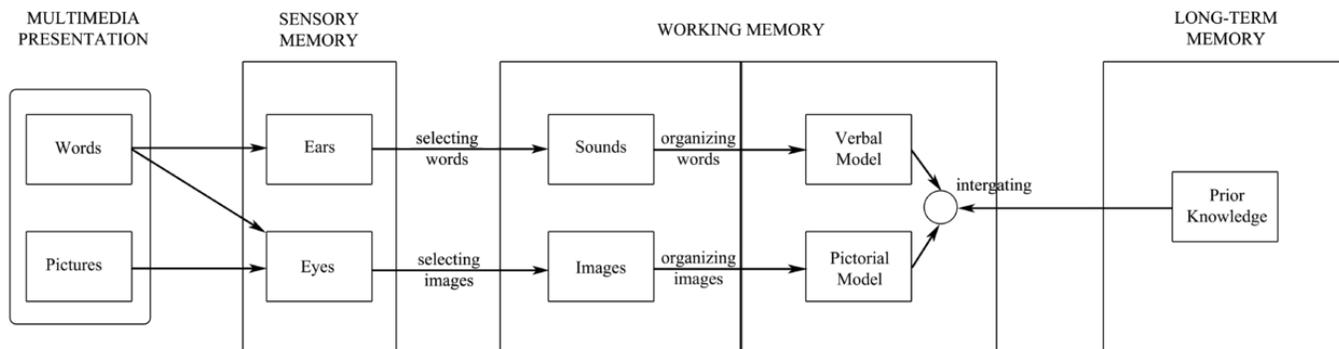
Name	Definition	Learner's Role	Teacher's Role
<b>Response strengthening</b>	Strengthening or weakening of an association	Passive recipient of rewards and punishments	Dispenser of rewards and punishments
<b>Information acquisition</b>	Adding information to memory	Passive recipient of information	Dispenser of information
<b>Knowledge construction</b>	Building cognitive representations	Active sense maker	Cognitive guide

## Model of Cognitive Theory of Multimedia Learning (Mayer, 2005)

Metaphors for learning are fine, but let's consider a model for the cognitive processes that are required to make learning meaningful to our learners. when using multimedia learning.

Process	Description	Location
<b>Selecting</b>	Paying attention to relevant words and pictures	Transfer information from sensory memory to working memory
<b>Organizing</b>	Organizing selected words and pictures into coherent mental representations	Manipulating information in working memory
<b>Integrating</b>	Connecting verbal and pictorial representations with each other and with prior knowledge	Transfer knowledge from long term memory to working memory

Here is a look at the entire model of cognitive theory by Mayer (2005).



### Active Processing

Following the model below, when learner are actively processing information meaningful learning can occur because learners can engage in appropriate cognitive processing during learning (e.g. attending to relevant material, organizing it into a coherent representation, and integrating it with relevant prior knowledge).

There are two factors that have an influence on our ability to process actively these are dual channels and limited capacity.

**Dual Channels:** People have separate channels to process verbal and visual material

**Limited Capacity:** People can only process small amounts of material in each channel at any one time

### Measuring Learning

Now that we know how the cognitive process is supposed to work, how can we measure if learning has occurred? We have two simple tests we can perform.

Type of test	Goal of test	Definition	Example
<b>Retention</b>	Remembering	Recall or recognize the presented material	Please write down all you remember about the device described in the lesson.
<b>Transfer</b>	Understanding	Evaluate or use the material in a new situation	How would you improve the device you just learned about to make it more effective?

### How do I use this information when I Create Video Instruction?

Before we answer that question, let's recap your retention of what was already shared.

- I know that learning is a change and through my instruction I can manipulate the learners experience so that students intentionally learn.
- I know that the goal of my instruction is to help student acquire information and construction knowledge.

- I know that I can prepare videos that select the right information to help students organize this information so they can integrate it within their existing long term memory.
- When I deliver this video instruction, I know students have separate channels to process verbal and visual materials, which both have a limited capacity and can only process small amounts of information.
- I know that I can test if students have learned through retention by asking them to recall or recognize the presented material. Further, I can see if they understand the material by asking them to evaluate or use the material in a new situation --- transfer.

### Three Ways to Reduce Demands on Learners During Video Instruction

Type of test	Goal of test	Definition
Reduce or eliminate Extraneous processing	Cognitive processing that does not support the objective of the lesson; caused by poor instructional design.	<ul style="list-style-type: none"> <li>• <a href="#">Coherent</a></li> <li>• <a href="#">Signaling</a></li> <li>• <a href="#">Redundancy Spatial</a></li> <li>• <a href="#">Continuity</a></li> <li>• <a href="#">Temporal Contiguity Principle</a></li> </ul>
Manage Essential processing	Basic cognitive processing required to mentally represent the presented material; caused by the inherent complexity of the material.	<ul style="list-style-type: none"> <li>• <a href="#">Segmenting</a></li> <li>• <a href="#">Pre-testing Principle</a></li> <li>• <a href="#">Modality</a></li> </ul>
Foster or motivate Generative processing	Deep cognitive processing required to make sense of the presented material; caused by learner's motivation to make an effort to learn.	<ul style="list-style-type: none"> <li>• <a href="#">Personalization principle</a></li> <li>• <a href="#">Voice principle</a></li> </ul>

### References

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