

Building Multimedia Lessons in Ways that are Compatible with the Human Learning Processes

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Abstract

Building multimedia lessons in ways that are compatible with the human learning process can be challenging, especially if the designer doesn't understand how the human mind learns.

However; based on evidence, research, and Richard Mayer's Multimedia Principles designers are able to construct lessons that are effective. This paper provides the framework of how multimedia lessons should be designed.

Building Multimedia Lessons in Ways that are Compatible with the Human Learning Processes

According to Mayer (2009), “People learn better from words and pictures than from words alone” (p. 4). This is a straightforward statement that summarizes the promise of multimedia learning, but how do you design the words and pictures? What approach should you use when creating instructional messages? Do you make assumptions of how people learn and begin to create lessons? These are some of the questions that every designer faces before creating lessons. This paper examines these questions to gain a better understanding of how to build multimedia lessons.

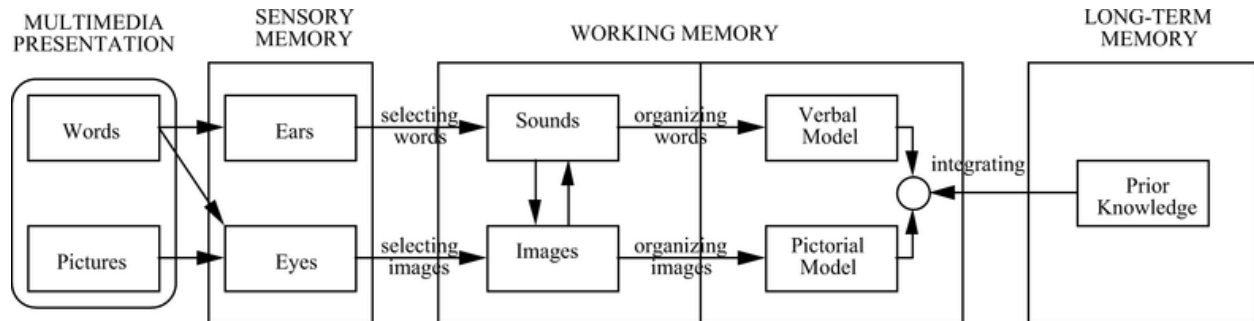
So what is learning? According to Mayer (2009), “Learning is a change in knowledge attributable to experience” (p.59). This change in knowledge can’t be directly observed but must be deduced from a change in the learner’s behavior. The learner’s change in behavior is personal and depends on each individual’s cognitive processing.

The same concepts of learning are also applied to multimedia learning with the inclusion of words and pictures. These words and pictures can be anything from photos, charts, narrated animation, or even reading a book and are not limited to e-learning. Hence, multimedia learning can be defined as anything that uses words (both verbal and printed) and pictures to promote learning.

So how does multimedia learning work? The most relevant elements in a science of learning consist of three assumptions (a) dual channels—the idea that humans possess separate channels for processing visual and verbal material; (b) limited capacity—the idea that each channel can process only a small amount of material at any one time; and (c) active processing—the idea that deep learning depends on the learner’s cognitive processing during learning (Mayer

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2008). These three assumptions, also known as cognitive theory of multimedia learning, are displayed by the diagram below.



It is important to understand the human-information processing system in order to design effective multimedia learning. With the knowledge of the Cognitive Theory of Multimedia Learning instructors are able to recognize many things. They recognize that working memory has a limited capacity to process information. They are able to utilize both the auditory and visual channels in working memory increasing the overall amount of information the brain can process. And finally, they understand that printed text may be difficult to process when both auditory and visual channels are required. This recognition can assist the instructor in presenting information that can activate working memory and eventually produce long-term memory.

Once the instructor has an understanding of how the human mind learns then he or she can attempt to apply the science of instruction. The science of instruction is concerned with how to present material in ways that prime appropriate cognitive processing during learning. The presentation of the material should include a learning objective used to describe the intended change in knowledge and an outcome to measure the change in the learner's knowledge (Mayer 2008). However, when choosing to present the material the instructor should not get caught up in the medium used. He or she should use a learner-centered approach that is consistent with the way the human mind works based on evidence. It is with this evidence-based approach that

designers should determine which instructional methods to use to create effective multimedia lessons.

An instructional method is a way of using spoken versus printed text and animation to present a lesson (Mayer 2009). In essence, the content remains the same during the lesson, but the words are spoken instead of printed. The spoken word format of instructional design can be broken down in ten principles: five principles for reducing extraneous processing, three principles for managing essential processing, and two principles for fostering generative processing (Mayer 2008). These principles are based on extensive research and should be an important framework to consider when building a multimedia lesson.

### **Principles for Reducing Extraneous Processing in Multimedia Learning**

The Cognitive Theory of Multimedia Learning shows that the brain has limited resources when it comes to learning. These limited resources should not be wasted on extraneous material and should be focused on achieving the instructional goal. The designer must be able to identify the five signs of extraneous overload: coherence, signaling, redundancy, spatial, and temporal, in order to maximize retention and transfer.

**Coherence Principle.** Squandering the learner's limited brain processing functions on extraneous information is a detriment to learning. Learning is most effective when interesting but irrelevant material is eliminated because of the brain's limited information processing resources. The learner's resources should be focused on essential information aligned with instructional goals. Multimedia designers and instructors should resist the urge to include extraneous material whenever necessary (Mayer 2009).

**Signaling Principle.** According to Mayer (2009), “People learn better when cues that highlight the organization of the essential material are added” (p. 108). These cues have been shown to be effective in improving learning from text especially in hypertext learning environments. The cues help guide a learner’s focus on important material and away from extraneous material.

**Redundancy Principle.** Information should be presented in as many forms as possible, because each learner is unique and can choose which format best suits them. According to this view, learners should learn better from animation, narration, and on-screen text than from just animation and narration. However; based on the cognitive theory, redundant text grouped with animation and narration will overload the learner’s processing system. Research has shown that students learn more when extraneous and redundant information is not included in a multimedia presentation (Kalyuga, Chandler and Sweller 1999).

**Spatial Contiguity Principle.** Multimedia lessons that have text and pictures presented close together are more effective than those that present text and pictures far apart. This is based on the theory that learners do not have to use cognitive resources to visually search the media and are more likely to hold both in working memory at the same time (Mayer 2009). Research has shown that presenting information on a single format of media is superior to presenting information on separate media (Chandler and Sweller, 1991).

**Temporal Contiguity Principle.** The successive-presentation format would seem to be the obvious choice to build animation and narration, because the learner would have two separate exposures to the explanation of a lesson rather than one. However, the Cognitive Theory of Multimedia Learning says that learners must have corresponding words and images in working

memory at the same time. Based on Cognitive Theory, words and pictures presented simultaneously would be more beneficial to the learner. The narration and animation presented together are more likely to contribute to effective learning than the presentation of narration followed by animation and vice versa (Chandler and Sweller, 1991).

### **Principles for Managing Essential Processing in Multimedia Learning**

Even if a multimedia designer could eliminate extraneous processing, there is still the possibility the demand of essential processing could overwhelm the learner with complex material (Mayer 2008). However; the designer is not simply able to remove the complex essential material. It contains the core information from the lesson that is needed to achieve the instructional goal (Mayer 2009). Therefore, the designer must learn to manage essential processing in three ways; the segmenting, pre-training, and modality principles.

**Segmenting Principle.** Each learner is different and may learn at different paces, but every learner requires some time to engage in the cognitive process. Research tells us that when learners are able to control the pace of the presentation they learn more (Schnotz 2002). Pacing can be achieved by breaking the presentation into segments. Shorter segments allow users to select segments at their own pace and work better than longer segments that offer less control. With these segments, the learner is more likely to engage in complete cognitive processing and have a better understanding of the material.

**Pre-training Principle.** According to Mayer (2009), “Pretraining is intended to manage essential processing during the presentation of narrated animation. The theoretical rationale is that learners who are already familiar with the names, locations, and behavior of each component can devote more of their cognitive capacity to building a cause-and-effect model of the system

“(p. 765). This frees up the learner’s essential processing and limiting the chance of the mind going into essential overload creating a deeper understanding of the material.

**Modality Principle.** The fundamental principle behind multimedia learning is people learn better from words and pictures than from words alone. Under these circumstances, words include written and spoken text, and the pictures include graphic images, animation, and video. Using both words and pictures is more effective than words alone and is consistent with research of how the brain processes information. Past research has shown that the use of both words and pictures allow the brain to process more information in working memory (Sweller 2005).

### **Principles for Fostering Generative Processing in Multimedia Learning**

Once the designer is successful in reducing extraneous processing and managing essential processing, the learner now has cognitive capacity available for generative processing. However; sometimes the learner chooses not to use the available capacity and make sense of the material, otherwise known as generative processing underutilization (Mayer 2009). The designer should find ways to induce learners to engage generative processing rather than simply use the processing they already have. Consequently, there are a couple of principles the designer can use to aid in fostering generative processing; the multimedia principle and the personalization/voice principle.

**Multimedia Principle.** When only narration is presented, the learner may construct a verbal model but may not be able to construct a pictorial model. When both animation and narration are presented together, the learner is able to build connections between a verbal representation and a pictorial representation of the same material engaging in deeper learning. These connections, or cognitive processes of integration, are an important way to promote



understanding (Mayer 2003). By using multiple channels of working memory, the designer can increase the likelihood that information will be effectively integrated into long term memory.

**Personalization and Voice Principle.** Multimedia that is more personalized engages learners more than multimedia that is less personalized (Mayer 2005). This statement is based on the personalization principle in which people learn better from presentations when words are in a more conversational style than those that have a more formal style. The personalization approach creates a sense of social partnership in which learners try harder to make sense of what their counterpart is saying encouraging learners to engage in each of the cognitive processes.

### **Conclusion**

Understanding how the mind works will help instructors begin to make better decisions and build lessons that will help people learn. It should be noted that designers should use an evidence based learner centered approach to design multimedia lessons based on how the human mind learns. Combined with Mayer's Principles of Multimedia Learning, this approach should be used for the creation of effective multimedia lessons.

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