

# Cognitive Theory of Multimedia Learning

## General

Cognitive theory of multimedia learning is one of the [cognitivist learning theories](#) introduced by an American psychology professor [Richard Mayer](#) in the 1990s. This theory is a sub-theory of the [cognitive load theory](#) applied especially for multimedia learning, and therefore has many similarities with it. Basic assumption of Mayer's theory is that the **human working memory** has **two sub-components** that **work in parallel** (visual and verbal/acoustic) and that learning can be more successful if both of this channels are used for information processing at the same time.

## What is cognitive theory of multimedia learning?

Mayer's theory is based on three assumptions suggested by cognitive research<sup>1,2</sup>:



- Dual-channel assumption** - The verbal and visual channels (similar to what Baddeley called *phonological loop system* and *visuospatial sketchpad*<sup>3</sup>) in our working memory are separated and can be used for processing information simultaneously thus enhancing process of learning. The suggestion that human working memory has more sub-components firstly came from the working memory models designed by [Alan Baddeley](#) and [Graham Hitch](#) in 1974<sup>4</sup> and reviewed by Baddeley in 1992<sup>5</sup>. These findings were further incorporated to the [Dual coding theory](#) by [Allan Paivio](#)<sup>6</sup> and later by Mayer and his colleagues.
- Limited capacity assumption** - As Miller's [Information processing theory](#) has shown, these channels have limited capacity<sup>7</sup> and limited time<sup>8</sup> they can hold information. Too much information can therefore cause *cognitive overload*.<sup>9</sup>
- Active-processing assumption** - Learning is an active process of collecting, organizing and integrating new information<sup>10</sup>. Similarities with [constructivist learning](#) may be noticed in this definition.

Together with [cognitive load theory](#), which offers a more detailed description of cognitive load types and possible causes of cognitive overload, the mentioned assumptions of cognitive theory of multimedia learning form a framework and **theoretical basis** for most contemporary research on learning. This research is mostly oriented on two goals:

- utilizing both information processing channels, and
- managing cognitive load and avoiding cognitive overload.

Research results have revealed a number of so called [principles and effects](#) describing different phenomena related to learning, instructional aids and ways of reducing cognitive load.

## What is the practical meaning of cognitive theory of multimedia learning?

As mentioned, research in frames of cognitive theory of multimedia learning and [cognitive load theory](#) has revealed a number of [principles and effects](#) introduced by Sweller, Mayer<sup>11)</sup>, and a number of other researchers. Simplified, these principles and effects suggest that students learn better:

- from **words and pictures** than from words alone,
- from **animation and narration** together than only from animation or narration or on-screen text,
- when corresponding words and pictures are presented **close** rather than far from each other on the page or screen,
- when corresponding words and pictures are presented **simultaneously** rather than one after another,
- when extraneous interesting but irrelevant material is excluded rather than included,
- when important information in the learning material is marked or emphasized,
- animation or text are broken down into smaller segments,
- when they are presented with worked examples before they try to solve a problem on their own,
- when they are prompted to self-explain a step in a procedure,
- when they study complex material in collaboration with other students,
- when their prior knowledge is activated prior to learning new material, and
- when they receive amount of guidance depending on their expertise level.

All of this design effects are stronger for low-knowledge learners than for high knowledge learners, and for high-spatial learners rather than for low-spatial learners.

## Criticisms

Cognitive theory of multimedia learning is mostly subjected to same [criticisms](#) as the cognitive load theory since it is an extension of it.

## Keywords and most important names

- **Cognitive theory of multimedia learning, dual coding theory, visual and verbal/acoustic channel, modality principle, redundancy principle, spatial contiguity principle, temporal contiguity principle, coherence principle, individual differences principle**
- [Richard Mayer](#)

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