Multimedia design principles

Learning outcomes: -

1. Learn about the epistemological theory of multimedia design
2. Apply the principles of multimedia design
3. Appreciate the importance of using media design principles to improve the learning process

We start with you with the following phrase:

Professor Myler, an expert in the field of multimedia use, said:

(Students learn better from words and pictures than words alone)

We all agree on that. To clarify, what is meant by the words here is the written or the audio words

As for images, they include still and animation images, videos, charts, shapes, maps, and others.

As for the process of improving learning, we mean by it the second and third levels of Bloom's cognitive hierarchy (understanding and application)

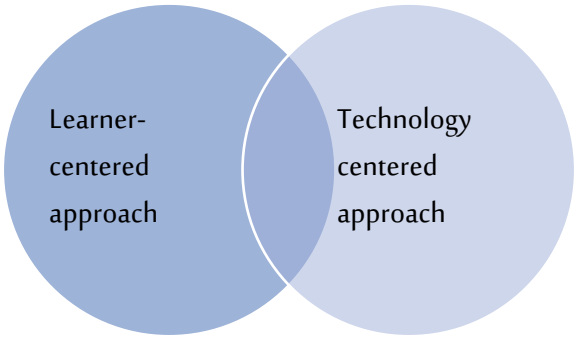
Now we must consider the following question:

"How can we design educational electronic content that includes words and pictures that help improve the learning process?"

The design of electronic content using multimedia depends on two main factors:

First: The type of technology used and we mean the technical tool with which we design, for example, the PowerPoint program

Second: Students' learning style using multimedia



Therefore, the combination of these two factors will help us provide an electronic educational content that results in improving and developing students' learning.

Important phrase:

"Today we serve technology. We need to reverse the machine-centered view and turn it into a person-centered view: Technology must serve us. “Norman" (1993)

We will focus with you in this training program on the second factor, which is "how students learn using multimedia."

Cognitive theory of learning using CTML

Cognitive Multimedia Learning Theory (CTML), is a research-based learning theory that specifically aims to explain how people learn from words and images. In other words, the theory centers on the idea that learners try to build meaningful connections between words and pictures

This theory is based on three basic assumptions (main assumptions):

1- There are two separate channels (audio and visual) for processing information.
2- There is limited capacity and capacity for each channel in the amount of information that can be processed simultaneously
3- Learning is an active process of filtering, selecting, organizing and merging information with other knowledge

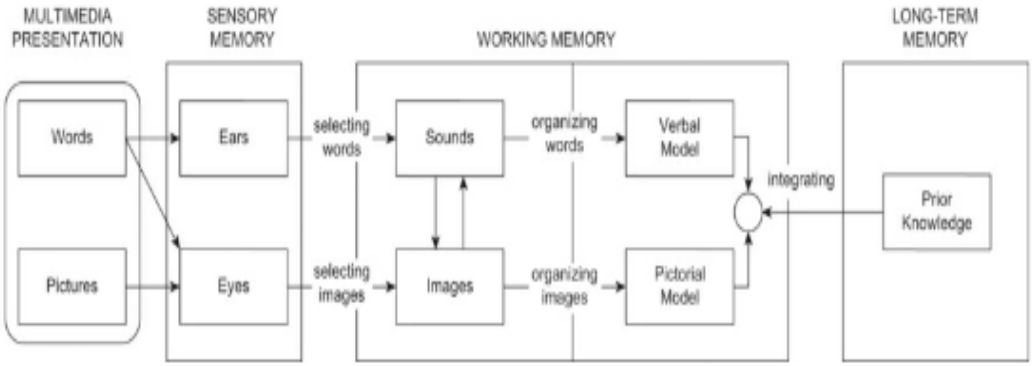


Figure 2.2 Cognitive theory of multimedia learning

It is noted that the memory has been divided into three stores:

1- The sensory memory that receives stimuli and stimuli and stores them for a very short period.
2- A process memory that actively processes information to create a mental structure
3- Long-term memory: It is a repository of all things previously learned

Based on this theory, the scientist Richard Meyer, since 2005 until now, has prepared principles of multimedia design. The principles mean the foundations that govern and organize the design of words and images when designing multimedia.

Design principles fall into three main groups

- (Reducing Extraneous Processing).
- (Managing Essential Processing).
- (Fostering Generative Processing).

External treatment minimization principles

What is extraneous treatment?

Extrinsic processing is cognitive processing during learning that does not serve the educational objective - such as attending to irrelevant information or erasing everything related to confusing lesson planning.

It is the situation in which the cognitive processing of the material extraneous in the lesson requires that there is little or no cognitive ability to participate in the primary or generative treatment. An extraneous processing overload is likely to occur when the lesson contains attention-grabbing foreign materials or when the lesson is awkwardly designed.

There are five principles to minimize external treatment:

(Reducing Extraneous Processing)

These principles discuss extraneous knowledge that constitutes redundant content that does not support the learning objectives and must be eliminated, so every text (printed or audible) or image (static, animated, video) or sound or musical effect that has nothing to do with the educational material is considered an excess that is not Only it is not necessary, it is harmful to the educational process, and it must be eliminated to reduce the pressure on the working memory of the learner, and these principles are:

First principle: Coherence principle

Cohesion principle: People learn better when extraneous materials are excluded rather than included. The principle of cohesion can be divided into three complementary versions:

(1) Learning is improved when interesting but irrelevant words and images are excluded from the multimedia presentation;
(2) Learning is improved when unnecessary words and symbols are removed from the multimedia presentation;

(3) Learning is improved when interesting but irrelevant music is excluded from the multimedia presentation. Each version of the principle of consistency is dealt with successively in this chapter.

Theoretical rationale: Extraneous materials compete for cognitive resources in working memory and can distract attention from the important subject, can disrupt the material organization process, and can push the learner to merge the material with an inappropriate subject.

Second principle: Signaling Principle

Signaling Principle: People learn best when adding cues that highlight the organization of the underlying substance.

Theoretical rationale: Verbal and visual cues reduce external processing by directing the learner's attention to the essential elements of the lesson and directing the learner's construction of the connections between them.

Theoretical rationale: Verbal and visual cues reduce external processing by directing the learner's attention to the key elements of the lesson and directing the learner's construction of the connections between them.

Boundary terms: verbal cues were effective in the form of classic signs (for example, adding outlines, headings, and cursor words) and graphic organizers (for example, the spatial arrangement of key terms in a structure such as an array) but not for distinguishing (for example, word placement) Keywords printed in red or use more phonetic emphasis for spoken keywords). The visual cues were effective in the form of specific pointing gestures (for example, when an agent on the screen indicated a specific part of the drawing that they were talking about) but not general pointing gestures (for example, when an agent on the screen was pointing in the general direction of the drawing); Visual cues are effective when visual and auditory cues are coordinated (for example, when part of the drawing turns red at the same time that the narrator gives audio confirmation of its spoken name) but not for changing color alone (for example, when part of the drawing turns into Red color). Signals may be particularly useful when using signals in moderation, when the learner has less skill or knowledge, and when the multimedia lesson is disorganized or contains a lot of foreign material.

Textual cues, which I refer to as verbal cues, focus on guiding the learner's handling of the verbal material. They can also help coordinate word hinting and corresponding images.
Image-based cues, or what I call visual cues, focus on guiding the learner's processing of the visual material. In short, we may not only refer to the verbal material but also the graphic matter. This means that we may wish to draw the learner's attention to specific parts of the drawing.

Third principle: Redundancy principle

Repetition principle: People don't learn better when printed text is added to graphics and narration. People learn better from graphics and narration than from graphics, narration and printed text, when the lesson is fast-paced.

Theoretical rationale: Repetition creates an odd processing: (a) because the visual channel can become overloaded with having to scan between images and text on the screen, and (b) learners put in a mental effort in trying to compare incoming streams of printed and spoken text.

Borderline Conditions: The negative effects of repetition can be reduced when (a) comments are reduced to a few words and placed next to the portion of the drawing they describe, (b) words unfamiliar or in a second language, and (c) none Short graphics and syllables. In each of these cases, external treatment is reduced

Fourth principle: Spatial Contiguity Principle

Spatial Communication Principle: People learn best when corresponding words and images are displayed near each other and not far from each other on the page or screen.

Theoretical rationale: When the corresponding words and images are close to each other on the page or screen, learners do not have to use the cognitive resources to visually search the page or screen, and learners are more likely to be able to retain them in working memory at the same time. When the

corresponding words and images are far from each other on the page or screen, learners have to use cognitive resources to search visually the page or screen, and the learners are less likely to be able to keep them in working memory at the same time.

Boundary conditions: The principle of spatial communication is more applicable when (a) the material is complex, (b) the diagram is not fully understood without words, (c) the learner is not familiar with the material.

Fifth principle: Temporal Contiguity Principle

Chronological communication principle: People learn better when corresponding words and images are presented simultaneously rather than consecutively. Theoretical rationale: When presenting the corresponding parts of the narration and animation at the same time, the learner is more able to maintain mental representations of both in working memory at the same time, and thus the learner is more capable of that. To build mental connections between verbal and visual representations. When the corresponding parts of the narration and animation are separated in time, the learner is less likely to be able to keep mental representations of both in working memory at the same time and, thus, it is unlikely to be able to build mental connections between verbal and visual proxies.

Core processors management

What is the primary treatment overload? - That is, the situation in which the cognitive processing of the main subject matter in the lesson requires that there is little or no remaining cognitive ability to participate in a deeper treatment of the material (which is what invokes obstetric therapy). Basic processing overload is likely to occur when the base material is complex, the learner is inexperienced, and the presentation is fast-paced.

What is the basic treatment? Basic processing is cognitive processing that aims to represent the key substances in your mentally working memory.

First: Segmenting Principle

Segmentation Principle: People learn best when a multimedia message is presented in segments at the user's pace rather than as a continuous unit.

Theoretical rationale: When viewing a fast-paced multimedia lesson that explains steps in the process, some learners may not fully understand one step in the process before introducing the next step, and thus, they may not have time to see the causal relationship between one step and the next.

Thus, the two main features of segmentation are (a) dividing the lesson into meaningful parts that are presented sequentially, and (b) allowing the learner to control the speed of movement from one part to another.

Second: Pre-Training Principle

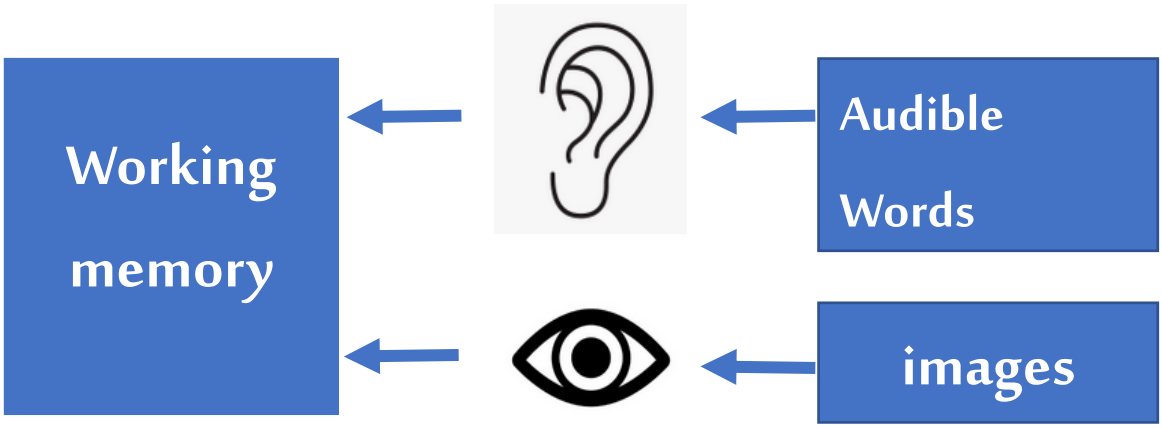
Pre-training principle: People learn deeper from the MMS when they know the names and characteristics of key concepts.

Theoretical rationale: When viewing a fast-paced animation explaining the steps in the process, learners have to build a causal model of the system (that is, a model of how the system works) as well as models formed for each major part of the system (i.e. a switch model that states that each part can be in it). Pre-training can help manage these two requirements of basic processing by distributing some of the processing to the pre-training episode that occurs before the main lesson. Likewise, when playing a science game or simulation that involves linking the game's procedure to relevant prior knowledge, pre-training can help provide or revitalize relevant prior knowledge.

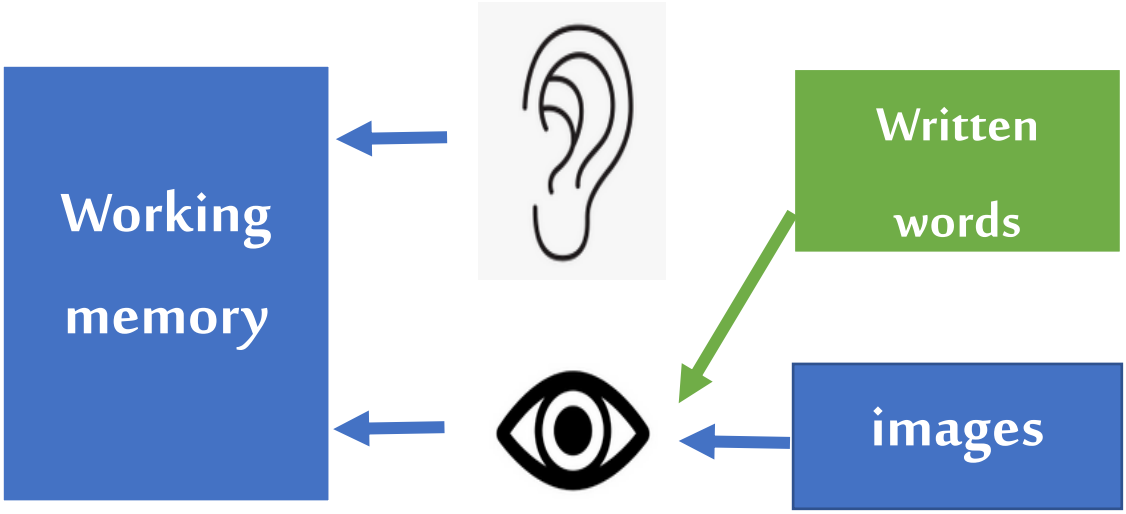
Third: Modality principle

Method principle: People learn from pictures and spoken words more deeply than pictures and printed words. Theoretical rationale: In an animated version with text appearing on the screen, both images and words enter the cognitive system through the eyes causing an overload in the visual system. In the animation version with narration, words are transcribed into the verbal channel, allowing

the learner to fully manipulate the images in the visual channel. Limit conditions: The principle of the method may be particularly applicable when the presentation is fast-paced, learners are familiar with words, the materials are complex, and the



tests focus on transfer. In contrast, printed words may be appropriate when the lesson includes technical words and symbols, when the learner is a speaker other than his native language, or when the lesson is quick.



Promote obstetric treatments

What is obstetric therapy? Obstetric therapy is a cognitive treatment that aims to understand matter and involves organizing incoming substances into coherent structures and integrating these structures with each other and with prior knowledge. This form of treatment is indicated by the regulation and integration arrows in Fig. 2.2 in Chapter 2. In the example of the scientific game, obstetric therapy involves building a mental model of how plants grow, including a causal chain linking the properties of roots and stems, and leaves with climatic factors.

Rendering Principle: People learn more deeply from multimedia presentations when an on-screen trainer is showing high avatar rather than low avatar.

Theoretical rationale: The coach who appears on the screen with a high embodiment can act as a positive social cue that creates a sense of social partnership in the learner, making the learner try more seriously to understand the educational message and thus learn more deeply. In contrast, an on-screen coach with low avatars can be distracting, because an on-screen character who is not behaving like a human may be annoying or harmless.

Boundary conditions: Having a highly-embodied coach on screen is most effective when there are no negative social cues to break the illusion of social partnership (such as the voice of a machine). Some forms of gestures may be more effective than others, such as gestures that involve specific gestures. Watching a teacher's drawing can be effective when the instructor's hand or the entire body appears during the drawing, but not when the drawing is dynamically generated without showing any hand or human body.

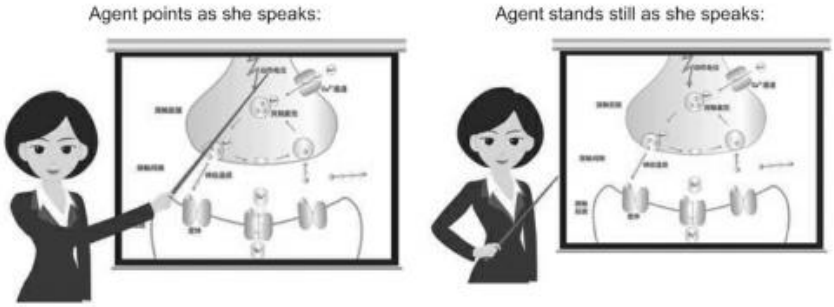


Figure 17.2 High-embodied agent (left panel) and low-embodied agent (right) for neural transmission lesson

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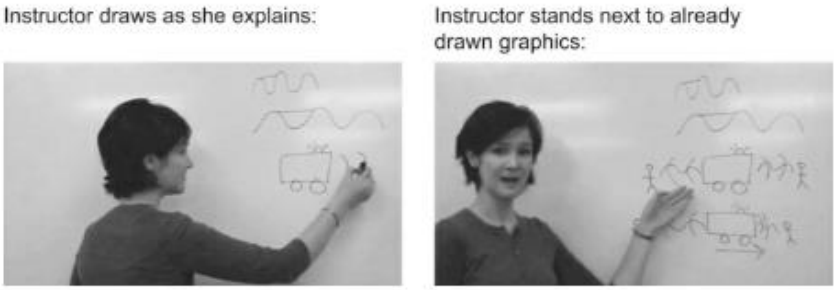

Figure 17.3 High-embodied instructor (left panel) and low-embodied instructor (right panel) for lesson on the Doppler Effect

Personification refers to the ways in which on-screen teachers can use their bodies to improve educational communication (Mayer, 2014). How can we create teachers who incorporate personification into multimedia educational messages? Examples of coaching personification include using hand gestures while speaking (rather than standing still), maintaining eye contact while speaking (rather than staring away from the learner), drawing drawings manually while speaking (rather than referring to already drawn drawings), or manipulating objects from a first-person perspective (as opposed to a third-person perspective). The principle of personification is that students learn more deeply when teachers display avatars rather than low avatars (Mayer, 2014).

<u>Generative Activity Principle</u>

The principle of generative activity

Generative Activity Principle: People learn best when they are instructed in carrying out generative learning activities during learning (for example, summarizing, mapping, drawing, visualizing, self-testing, self-interpretation, teaching, or execution). Example: After each of the six sections in a virtual reality simulation of the human bloodstream, students are asked to orally summarize what they have learned.

Theoretical rationale: Engaging in generative learning activities causes the learner to engage in appropriate cognitive processing during learning, such as selecting an important material and mentally organizing it into a coherent structure and integrating it with relevant prior knowledge that is activated from long-term memory. Empirical rationale:

ring. A generative learning activity (or generative activity for short) is something that a learner does during the learning loop with the aim of promoting deep learning of matter (Fiorella & Mayer, 2015, 2016). This definition of generative activity has three components: (1) it includes the behavior on the part of the learner, (2) the behavior occurs in the context of studying the lesson, and (3) the goal of the behavior is to help the learner better understand the material.

Types of obstetric activities:

Summarizing, mapping, drawing, visualizing, self-testing, self-interpretation, teaching, and execution.

Summarizing includes writing (or speaking) an abstract of the course material in your own words.

Mapping involves creating a spatial representation of key terms from the lesson.

The drawing includes creating an illustration that depicts the material in the lesson.

Visualization involves creating a mental picture that depicts the material in the lesson.

The self-test includes studying the material and then taking a practice test.

Self-interpretation includes adding your own interpretations of the material during the lesson, which may also be called elaboration. In the generative teaching activity, you are asked to prepare to give a brief explanation of the material in the lesson to another person.

As you can see, each of the eight generative activities aims to encourage the learner to think more deeply about the lesson by attending, organizing and integrating relevant material with prior knowledge. The prompts are entered into the lesson in a way that aims to guide and support the learner's generative activity. In this chapter, I explore what the research evidence says about the cognitive consequences of adding stimuli for generative activity to the lesson.

The purpose of each of the generative activities is to stimulate and, to some extent, direct the way in which the learner chooses (1) important information from the lesson for further analysis, (2) mentally organizes the selected material into a logical coherent learner structure, and (3) integrates the materials with relevant prior knowledge that is activated from long-term memory and integrates corresponding verbal and pictorial materials. According to the generative learning theory, engaging in these processes leads to deeper learning outcomes and will also be reflected in improved performance in transfer tests. Thus, we can predict that students who are required to participate in obstetric activities during learning will perform better on post-transfer tests than students who study the same subjects without claims for generative activities.