Multimedia Learning Principles

Source: Mayer, R. E. (2009). Multimedia learning 2nd Ed

Prof. Herman Dwi Surjono, Ph.D.
http://blog.uny.ac.id/hermansurjono

Learning Objectives

- Explain the cognitive theory of multimedia learning.
- Explain the cognitive load in multimedia learning.
- Explain the multimedia learning principles

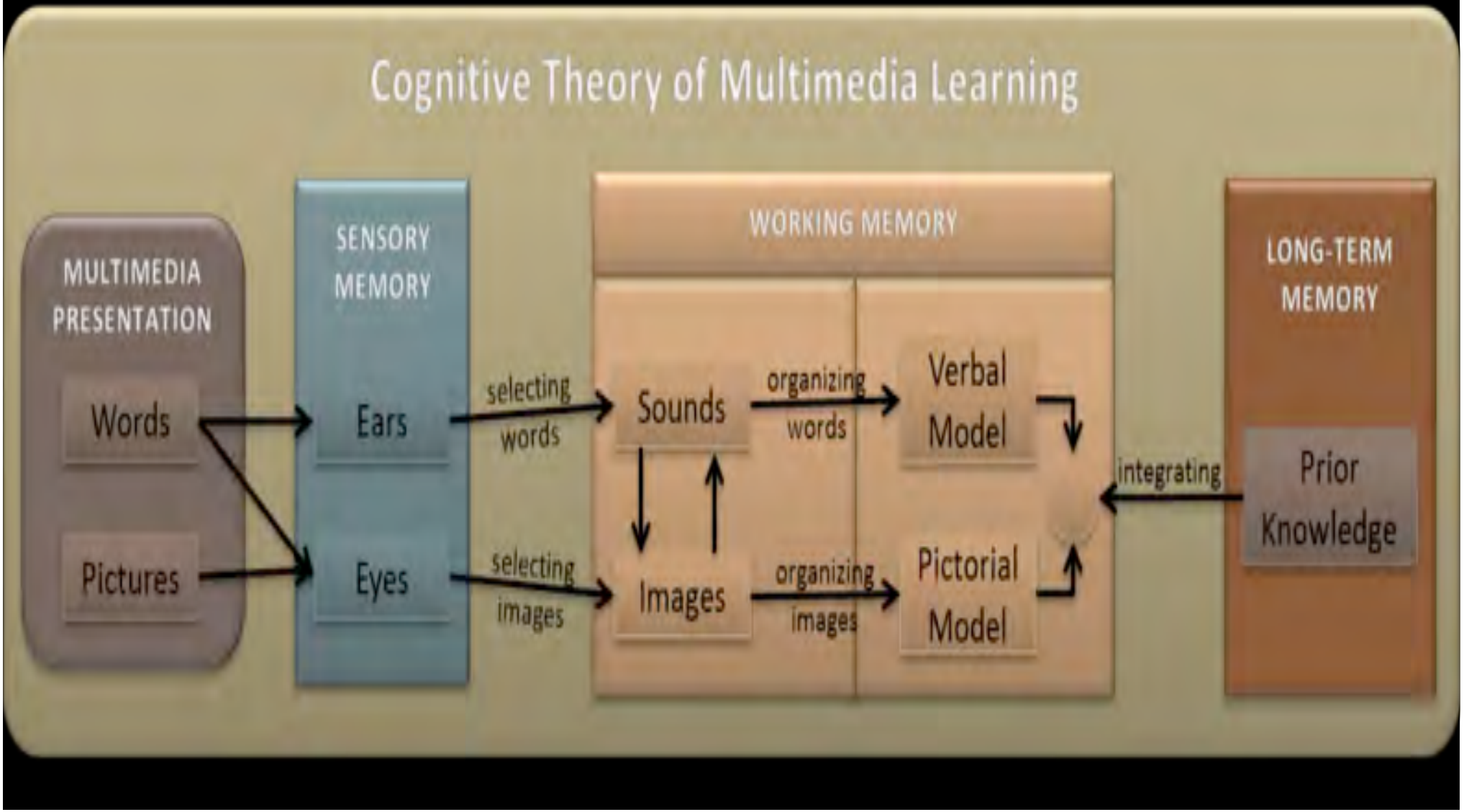
Pre-requisites

- What is multimedia?
- What is learning?
- What is interactive multimedia learning?

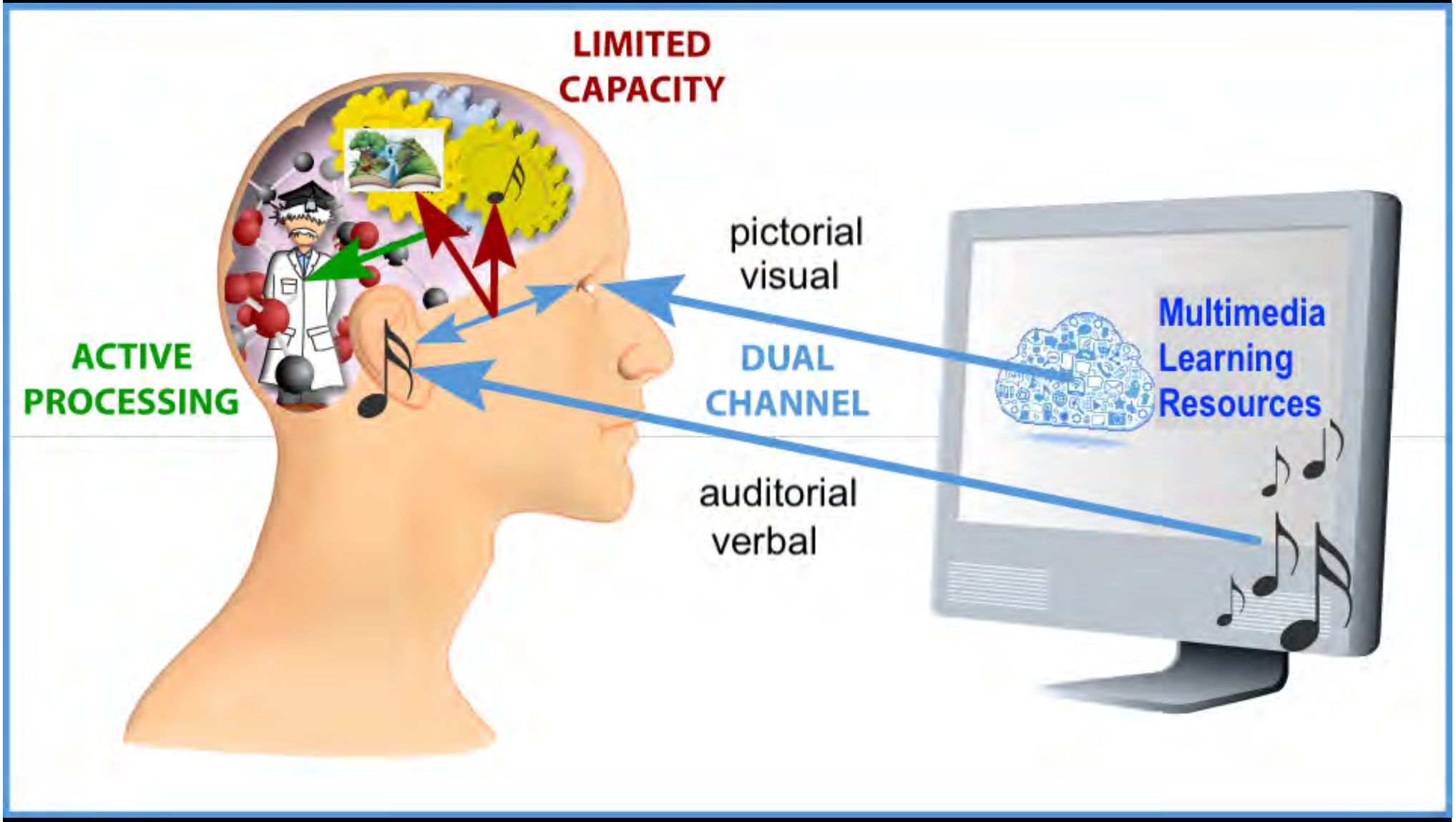
Multimedia Learning

- Multimedia learning is learning through words and images.
- Words?
- verbal information presented through printed or spoken text (narration)
- Image?
- visual information that is static (pictures, illustrations, graphics, photos) or dynamic (animation, video)

Cognitive Theory of Multimedia Learning (CTML)



Multimedia Learning Assumption



Dual-Channel Assumption

The dual-channel assumption is that humans possess separate information processing channels for

visually represented material and

auditorily represented material.

Limited-Capacity Assumption

Human are limited in the amount of information that can be processed in each channel at one time.

Active Cognitive Processes

humans actively engage in cognitive processing to construct a coherent mental representation of their experience

- Paying attention
- Organizing incoming information
- Integrating incoming information with other information

Cognitive Load

1. **Essential processing**
   Basic cognitive processing relevant to learning objectives.
2. **Generative processing**
   Deep cognitive processing is relevant to learning goals.
3. **Extraneous processing**
   Cognitive processing that is **not relevant** to the purpose of learning.

Challenges in Multimedia Learning

Reducing Extraneous Processing

- Coherence
- Signaling
- Redundancy
- Spatial contiguity
- Temporal contiguity

Managing Essential Processing

- Segmenting
- Pre-training
- Modality

Fostering Generative Processing

- Multimedia Principle
- Personalization Principle
- Interactivity

1
Multimedia principle:
materials will be more effective if it is presented with pictures and words rather than just words

The Multimedia Principle

- Include both words and graphics
- Why?
- Graphics facilitate active learning, mentally making connection between pictorial and verbal representations
- Words alone may cause shallow learning

Two kinds of pictures

- Decorative vs. explanative illustrations
- What's the difference?
- Decorative pictures are eye candy
- Explanative illustrations help learner understand the material
- Instructional designer's job is to enable learner to make sense of information

2
Contiguity principle:
pictures and explanations are better placed as close as possible (spatial & temporal)

Contiguity principle

- Spatial contiguity

  Pictures and explanations must be close together.

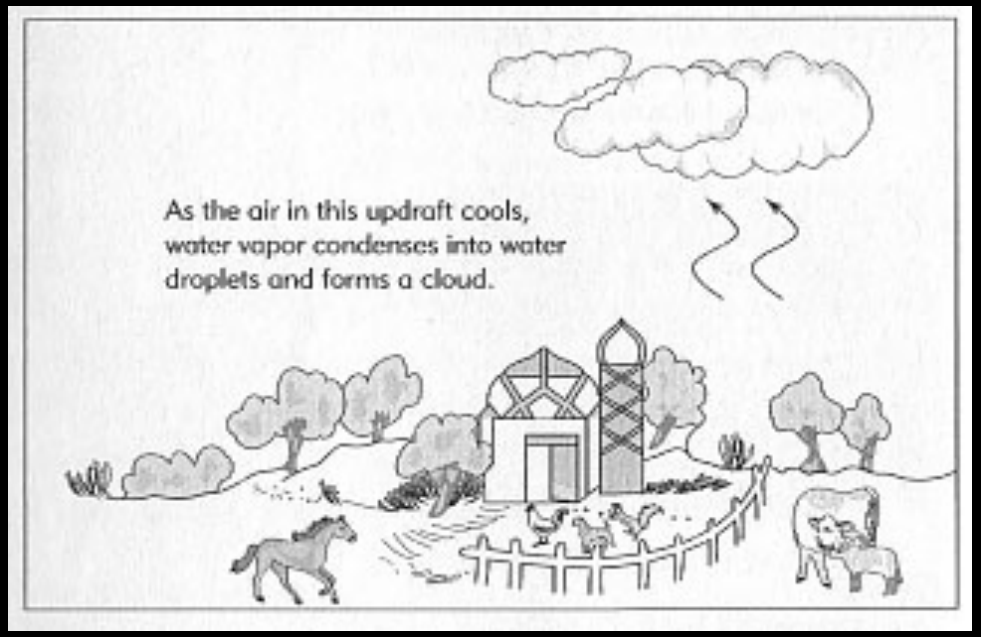
  Give illustration …

- Temporal contiguity

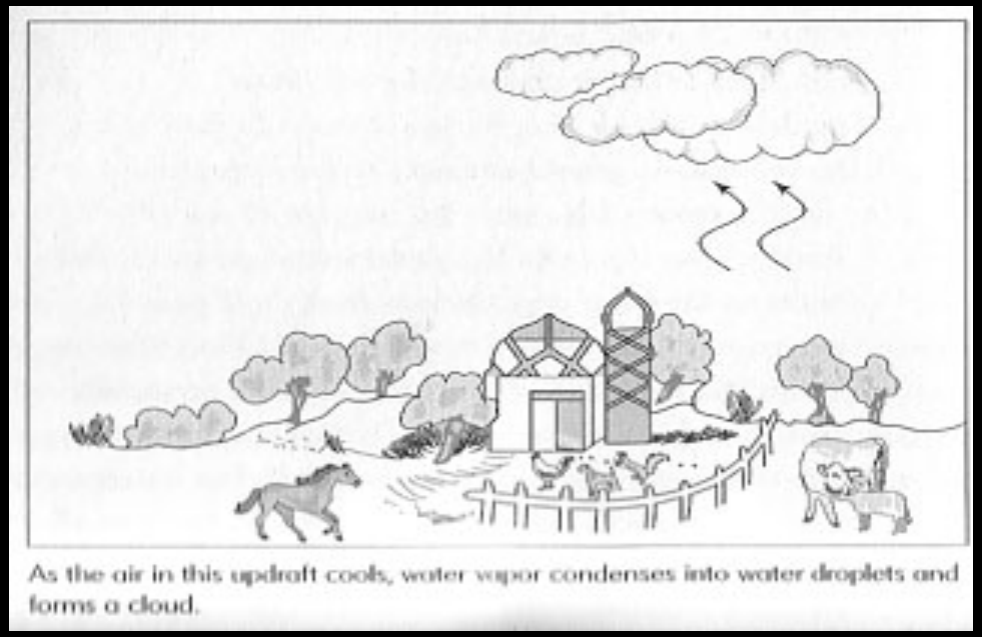
  The images/animation/video and narration must be in the same time.

  Give illustration …

Integrated vs. separate text



Text separate from graphic

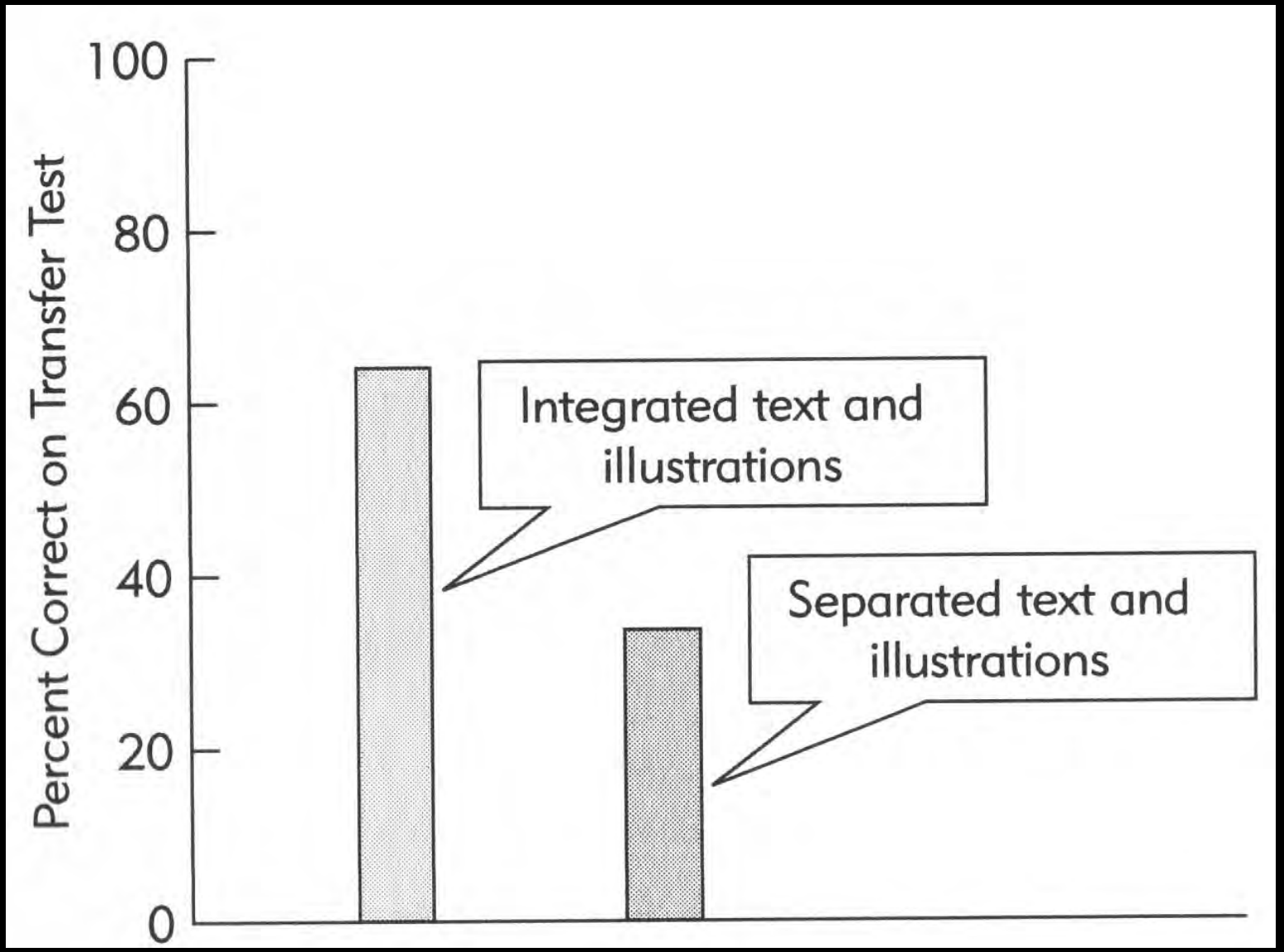


Text integrated into graphic

Other applications of contiguity principle

- Can we apply this principle in the following situation?
- Identifying parts in a diagram:
  - List of part names below the diagram?
  - Pointers connecting names to parts?
  - Hyperlinks from diagram image map to names and descriptions of parts?
  - Pop-up text as mouse rolls over parts?

Evidence for contiguity



Violations of contiguity

- Separating visuals and text
- Obscuring connection with scrolling text
- Feedback on a separate screen from practice question
- Second browser window covers related information on main screen
- Directions for exercise on separate screen from exercise itself

3
Coherence principle:
Words, images, sounds, videos that are not important / relevant should be removed

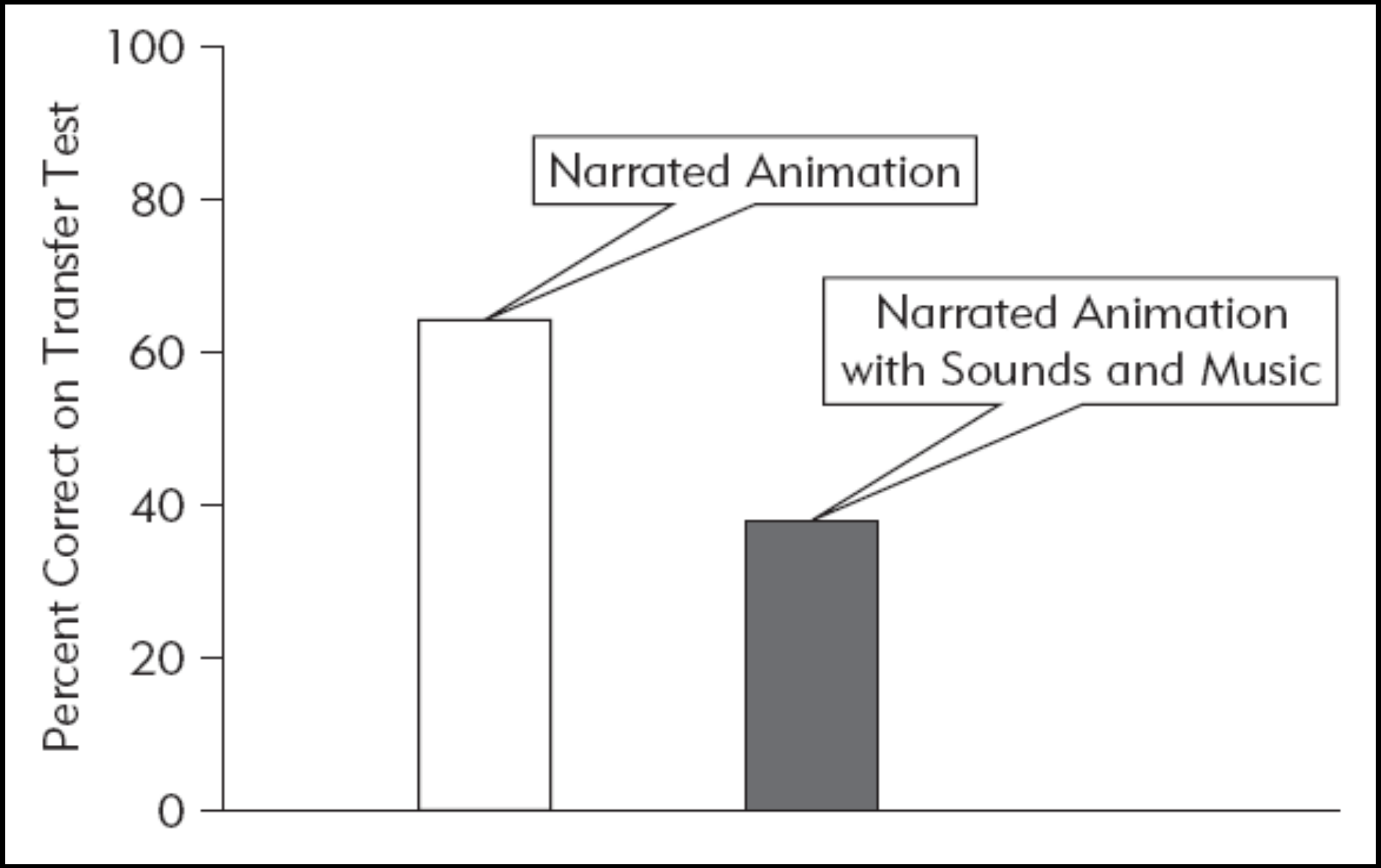
The Coherence Principle

- Interesting material can hinder learning
- Why?
  - Cognitive theory: learners have limited resources
  - Extraneous materials competes with core material for limited cognitive resources
- Coherence: all materials should cohere relevantly with what needs to be learned

Avoid extraneous sounds

- Background music and sounds may overload working memory
  - Especially when learner experiences heavy cognitive processing demands
- Give examples…

Learning Is Better When Sounds and Music Are Excluded



Avoid extraneous words

- Adding interesting sentences may seem like an easy way to increase interest
- Again, they may just distract learners
- Conclusion: avoid seductive but irrelevant details that force excitement but don't increase understanding
- Give examples…

Avoid Extraneous Graphics

- They are harmful to the extent that they can interfere with the learner's attempts to make sense of the presented material
- Extraneous graphics can be distracting and disruptive of the learning process.
- Give examples…

4

Modality principle:

more effective communication when words are presented as narration rather than printed text

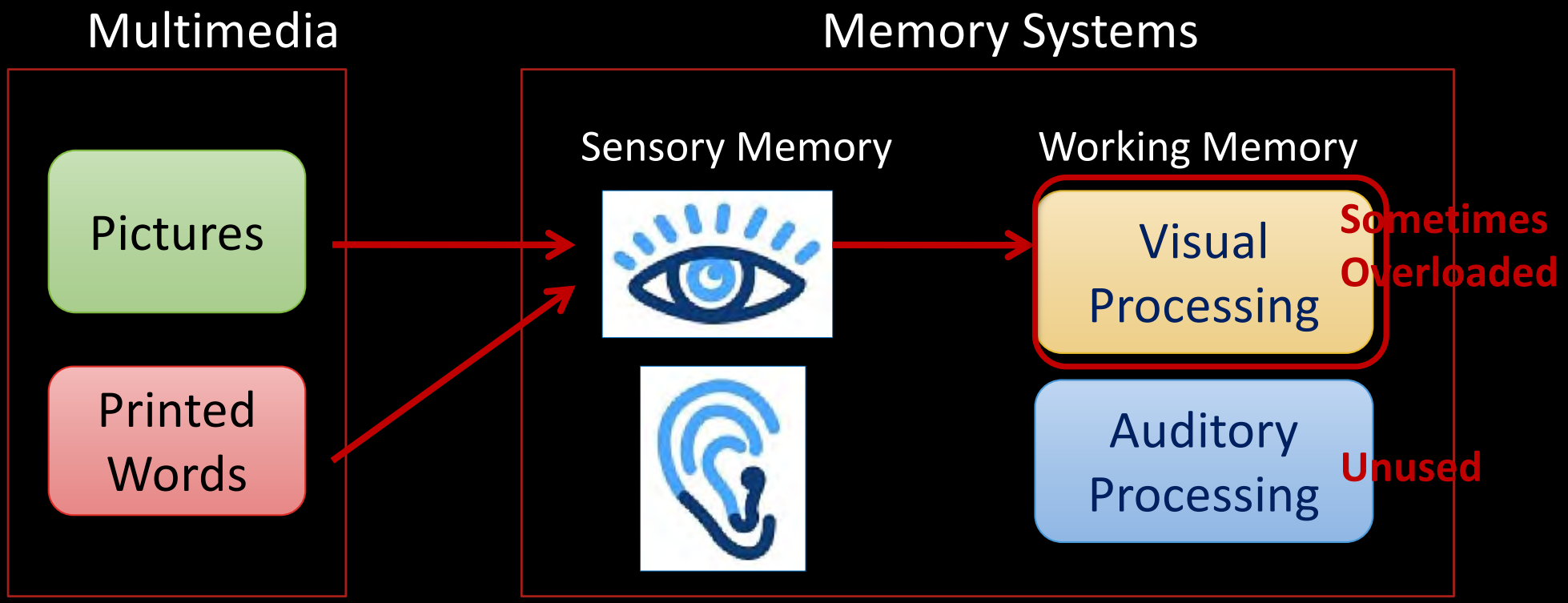
The Modality Principle

- Put words in spoken rather than graphic form, when graphic or animation is in focus
- Give examples…

Modality Principle

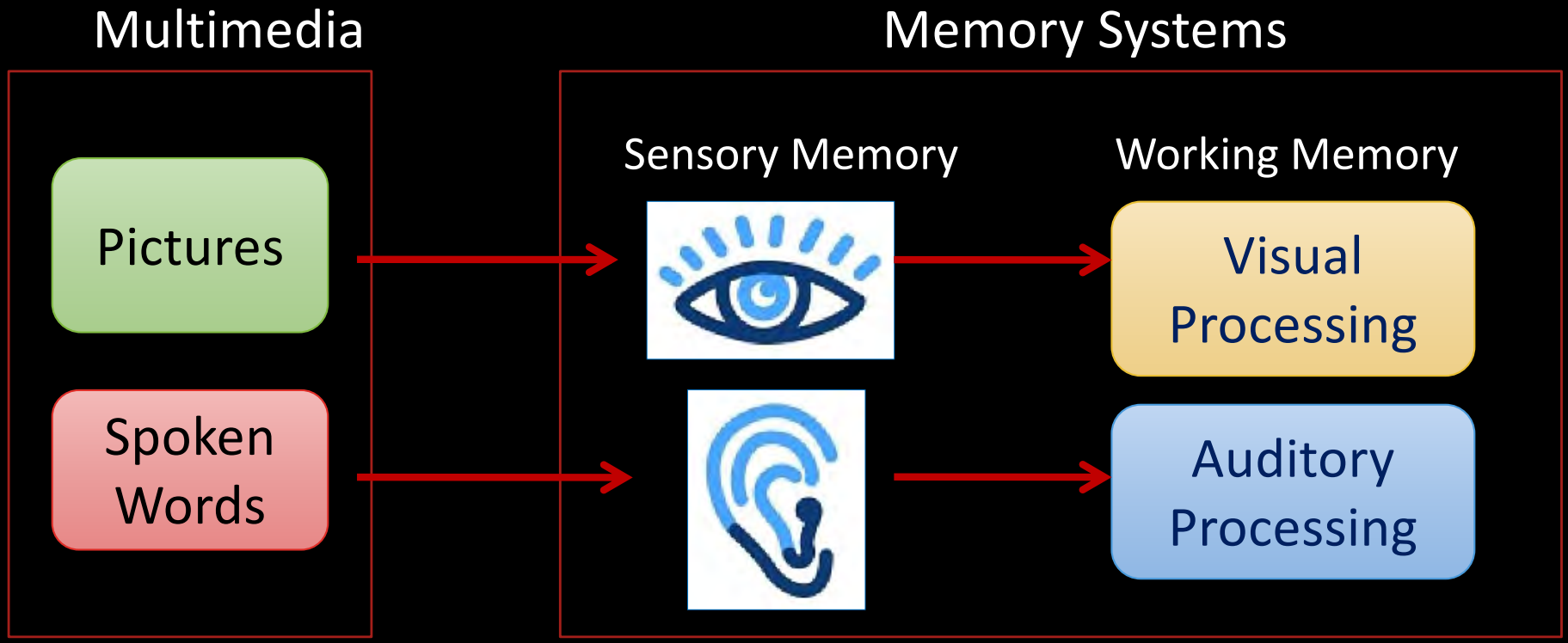
- Students receive the information better using animation + narration than using animation + on-screen text.
- According to CTML, the visual channel becomes overloaded when animation and on-screen text are together presented visually.

Animation + on-screen text



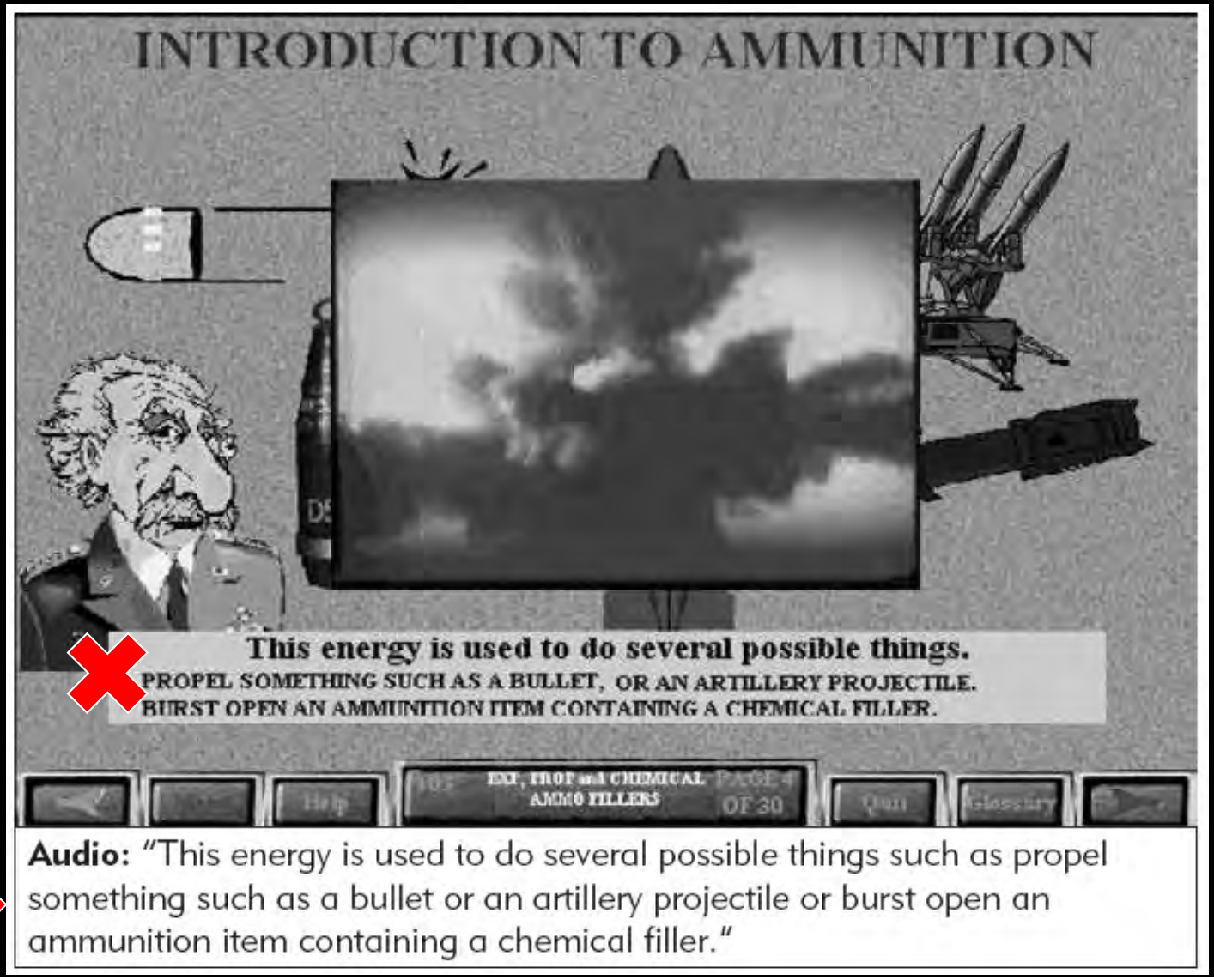
Visual channel becomes overloaded

Animation + narration



Better

Do Not Add On-Screen Text to Narrated Graphics



Audio: "This energy is used to do several possible things such as propel something such as a bullet or an artillery projectile or burst open an ammunition item containing a chemical filler."

5
Redundancy principle:
People learn better from graphics and narration than from graphics, narration, and printed text

Redundancy principles

- Avoid presenting words as narration and identical text
- Special cases for narration of text:
  - No pictorial representation on a screen
  - Slow pace of presentation
  - Helping learners with disabilities or non-native speakers
  - Learners who may not have access to speakers or headsets

6
Personalization principle:

People learn better from multimedia presentations when words are in conversational style rather than formal style

Personalization principle

- Conversational style aids learning
  - Formal style avoids first- and second-person: e.g., "Caution should be used when opening pyrotechnic containers."
  - Use second-person: "You should be careful if you open any containers with pyrotechnics."
- Why might informal style help learning?
  - People are easy to understand material when they feel they are in a conversation with a partner.
- Give examples…

7
Interactivity principle:
more effective communication when users can control the presentation rate

Does practice make perfect?

- Interactive practice exercises help learners integrate knowledge into LTM
- What kinds of exercises?
  - Drag-and-drop and simulations
  - More crucially: exercises should mirror thinking processes and environment of actual task
  - Better learning results from practice questions interspersed throughout the lesson
  - Learners should be trained to develop their own questions

Interactions should mirror the actual job or task

- Activities should require learners to respond in similar ways during training as they will on the job
- Avoid simple regurgitation of information provided in training program

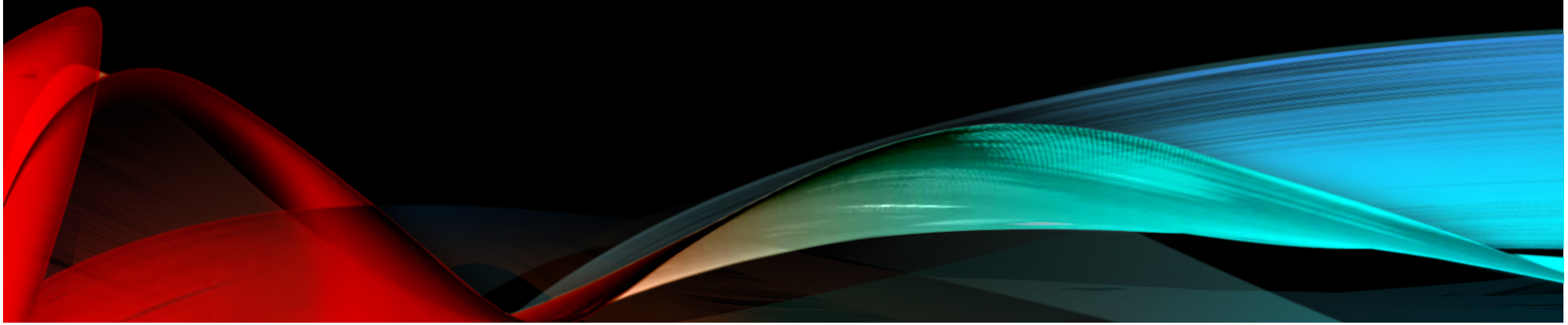
8
Signaling principle:
People learn better when cues that highlight the organization of the essential material are added

Examples

- introductory outline (1st, 2nd, 3rd, etc.)
- explanatory headers
- pointer words (showing causal relationships)

9
Segmenting Principle

"People learn better when a multimedia message is presented in user-paced segments rather than as a continuous unit"



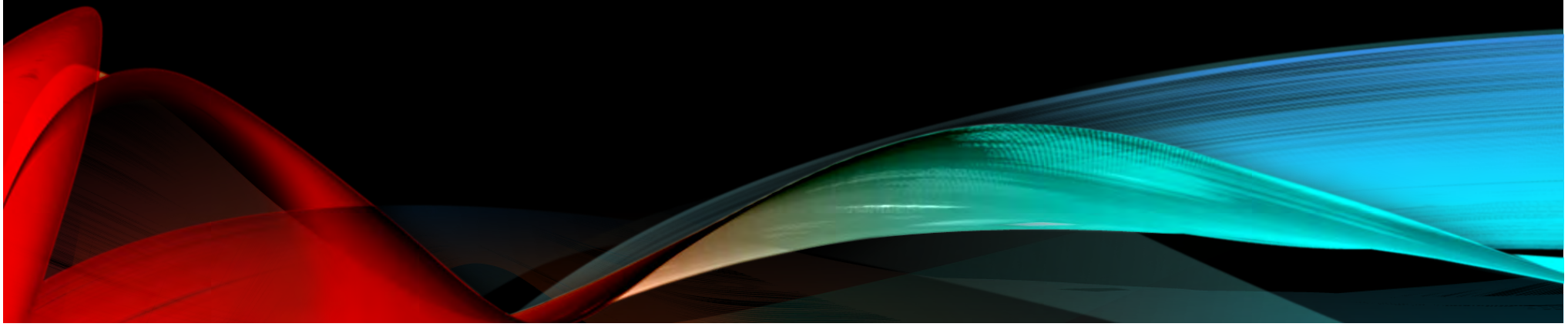
Segmenting Principles

- In videos / animations that are long and difficult to understand, it's best to cut them into pieces

  Give an example ...

10
Pre-training Principle

"People learn more deeply from a multimedia message when they know the names and characteristics of the main concepts"



Pre-training Principles

- In complex animations / videos it is best to give an explanation at the beginning about terms / components / parts that are difficult to understand.
  Give an example ...

Summary

- Use the principles of multimedia learning as much as possible in your multimedia project so students can learn optimally.