Tackling the Nitty-Gritty in Teaching Search Strategies: A Visualized Approach from a Human Cognition Perspective

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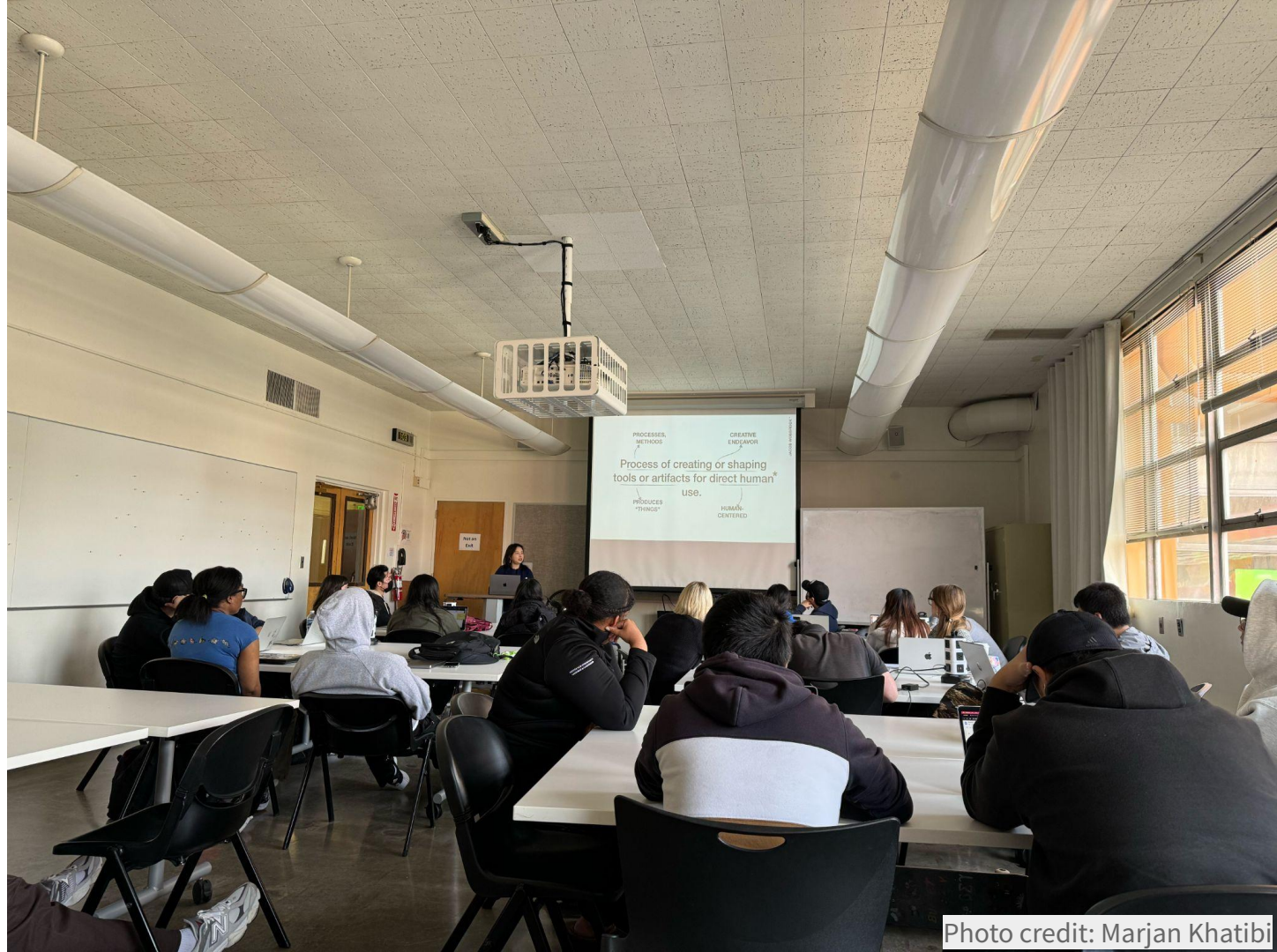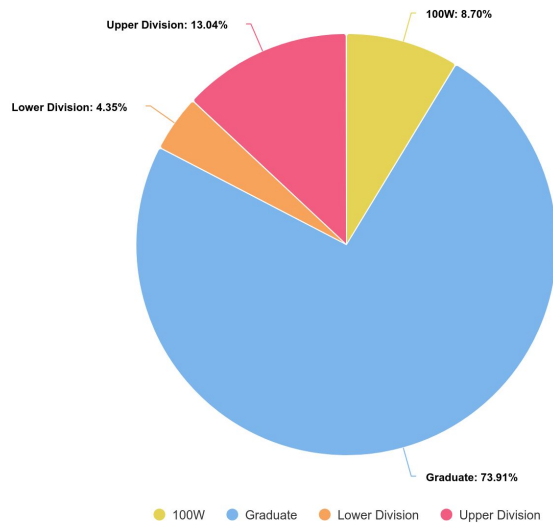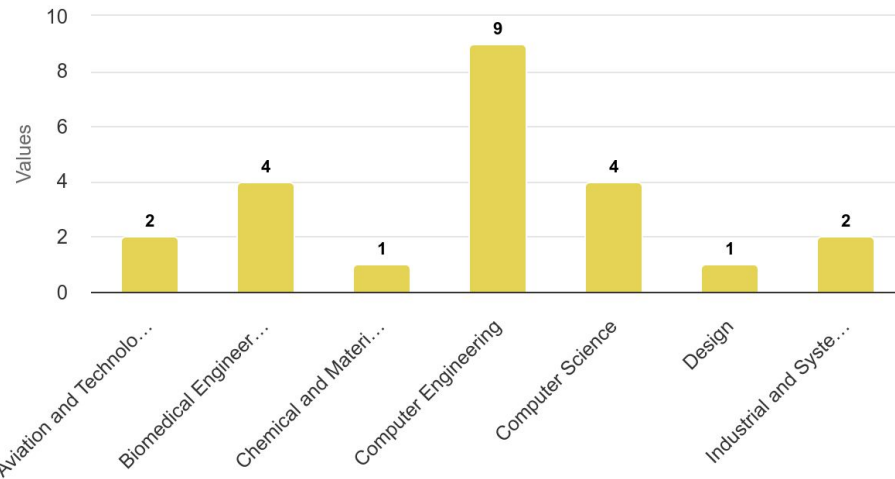
SAN JOSÉ STATE UNIVERSITY

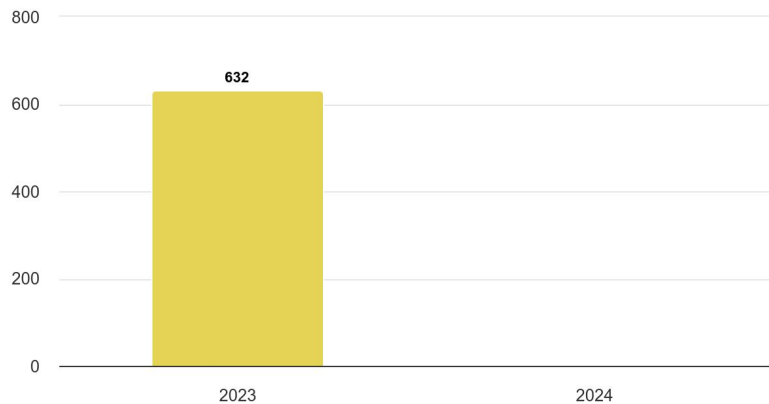One-Shot Library Instruction

Photo credit: Marjan Khatibi

Course Level

- 100W: 8.70%
- Upper Division: 13.04%
- Lower Division: 4.35%
- Graduate: 73.91%

Legend: 100W, Graduate, Lower Division, Upper Division

Course Subject

Subject	Values
Aviation and Technolo...	2
Biomedical Engineer...	4
Chemical and Materi...	1
Computer Engineering	9
Computer Science	4
Design	1
Industrial and Syste...	2

Course Subject

Fall 2023 Stats

Number of students

- 2023: 632
- 2024:

Session meeting format

- In-person: 47.83%
- Online, synchronous: 43.48%
- Online, asynchronous: 8.70%

Legend: In-person, Online, synchronous, Online, asynchronous
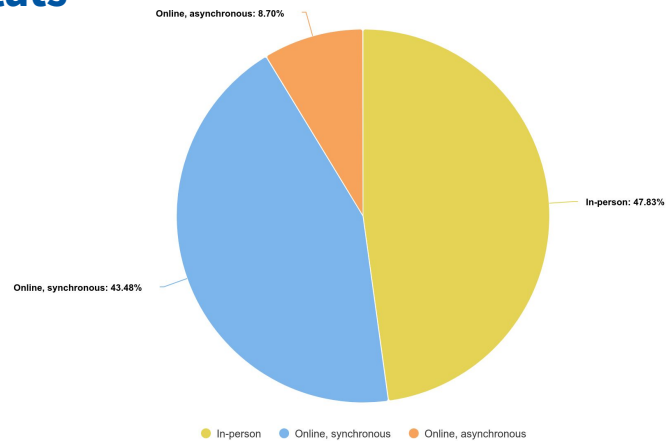
Problems

University students often **struggle** with constructing effective search strategies, leading to reliance on AI-powered tools, such as Google, ChatGPT.

Current teaching methods often result in **fleeting** skills.

Research Question

How we can **design instructions** that will more effectively **encode important information into students' long-term memory**, so that the **search skills** acquired during a single/one-shot library session can *persist and remain accessible* for their next search tasks?

Approach

Human Cognition-Based Approach:
- Human cognition theories explain how we process and retain new information
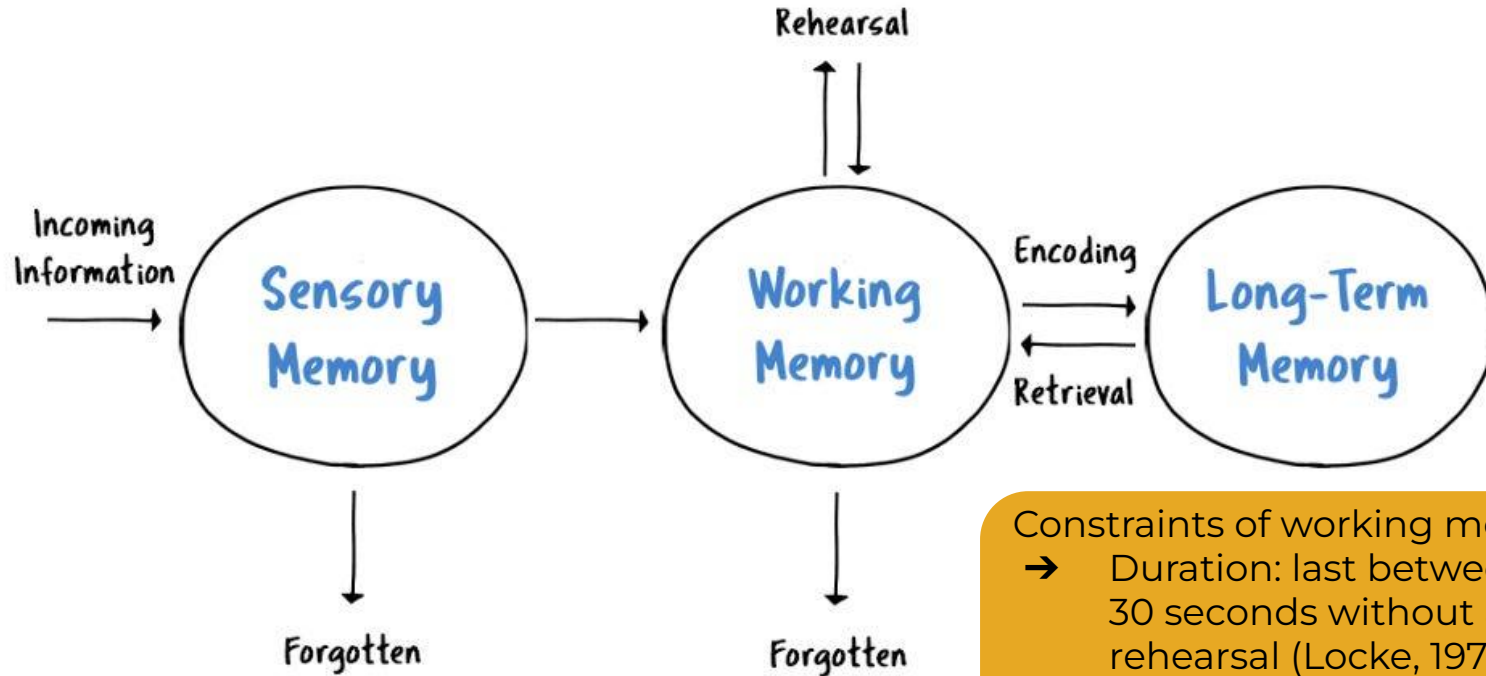- They guide the design of effective instructions

*Christian Horz/Adobe Stock
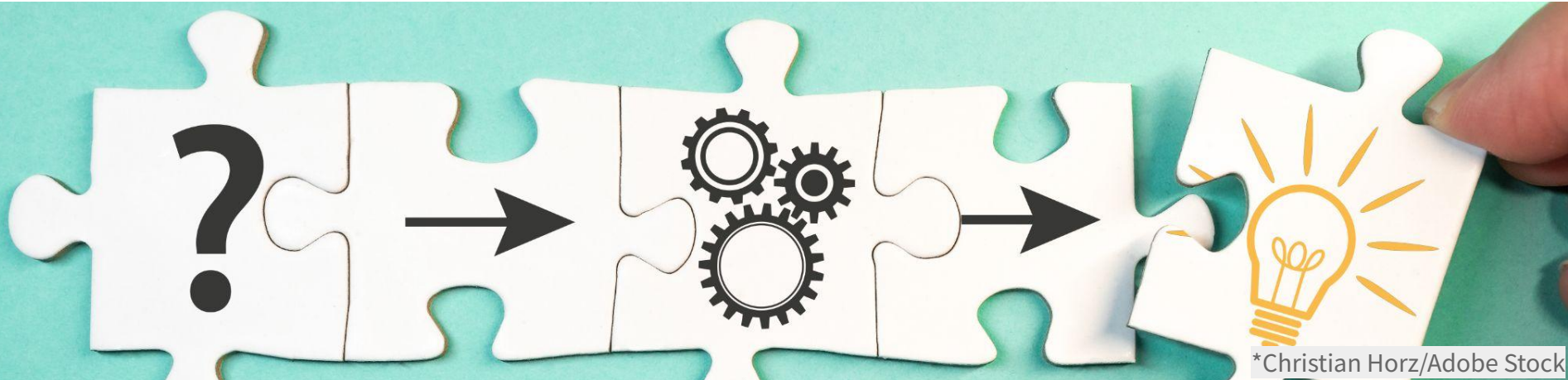
Contemporary Understanding of Human Cognition

- **Information-processing approach**: Mental activities as information flowing through sensory, short-term/working memory, and long-term memory stages (Atkinson & Shiffrin, 1968)
- **Constraints of short-term/working memory**: limited in duration and capacity (Atkinson & Shiffrin, 1968)
- **Multi-component working memory model**: Emphasizes active manipulation of information in short-term/working memory (Baddeley & Hitch, 1974)

Information Processing Model

Incoming Information → **Sensory Memory** → **Working Memory** → Encoding → **Long-Term Memory**
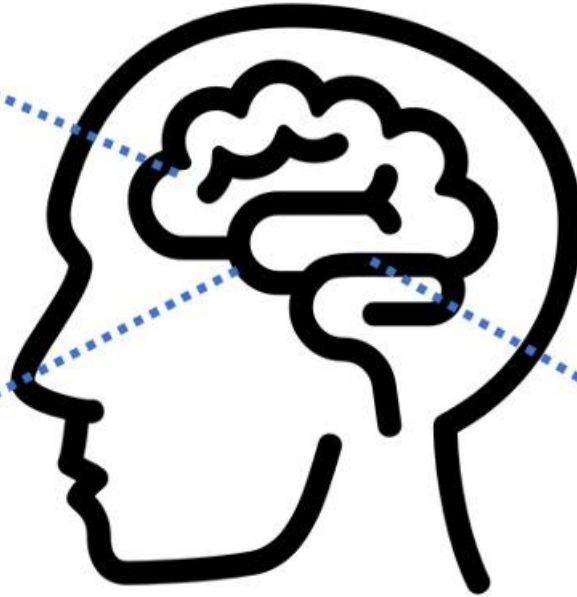
Rehearsal

Retrieval

Forgotten

Forgotten

Constraints of working memory:
➔ Duration: last between 15 and 30 seconds without active rehearsal (Locke, 1971)
➔ Capacity: no more than 4 chunks (Cowan, 2001)

Cognitive Load Theory

Intrinsic Load
(complexity of
new information)

Our goal:
➔ Manage intrinsic
load
➔ Decrease extraneous
load
➔ Increase aspects of
cognitive load that
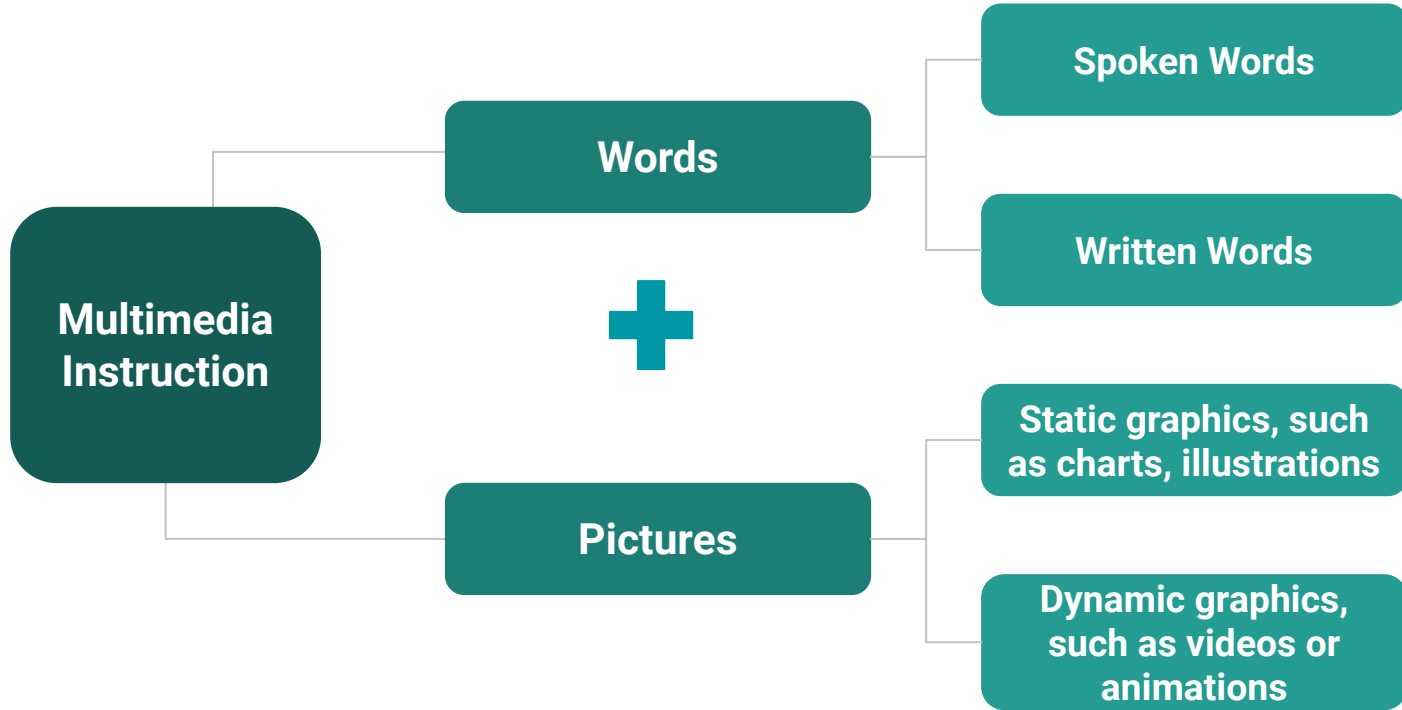leads to learning

Germane Load
(linking new info
with current info)

CLT emphasizes tailored instruction,
with novices benefiting more from
multimedia
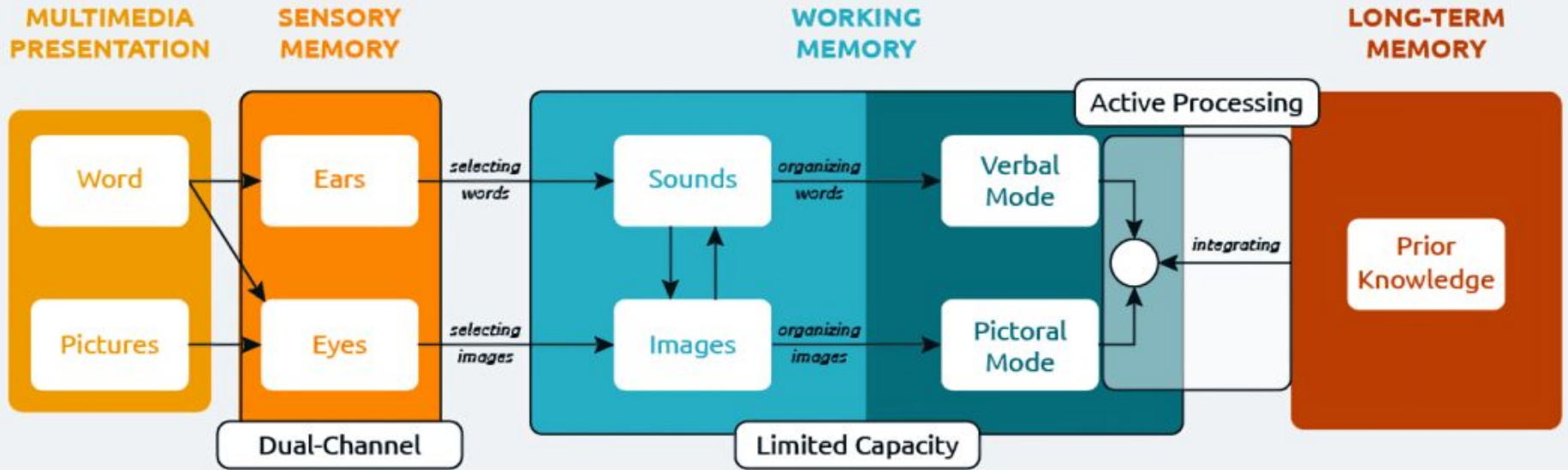
Extraneous Load
(unnecessary and
distracting info)

"People learn better from words and pictures than from words alone" (Mayer, 2009, p.4)

Multimedia Instruction

Words
- Spoken Words
- Written Words

+

Pictures
- Static graphics, such as charts, illustrations
- Dynamic graphics, such as videos or animations

Mayer's Cognitive Theory of Multimedia Learning

Cognitive Theory of Multimedia Learning

Adapted from: Mayer, R.E. (2020). Multimedia Learning (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781316941355

Principle	Source	Description	Effect Size	Implications
Multimedia	CTML	People learn better from words and graphics than from words alone	1.39	Utilizing **a combination of graphics and narrations** to demonstrate the steps involved in constructing a search strategy, particularly beneficial for **inexperienced learners**
Expertise Reversal	CLT	Multimedia learning result in better learning outcomes for learners with low prior knowledge than those with higher knowledge levels	NA	
Individual Difference	CTML		NA	
Modality	CLT & CTML	People learn better from a multimedia message when words are presented in spoken form	0.72	
Temporal Contiguity	CTML	People learn better when spoken words are synchronized with corresponding graphics	1.30	
Segmenting	CLT & CTML	People learn better when a multimedia message is presented at learner-paced segments rather than a continuous presentation	0.70	**Breaking down complexity into distinct steps** with clear headings
Coherence	CTML	Learning is enhanced when extraneous information is removed	0.70	**Exclusively employing graphics and text that directly** contribute to the content

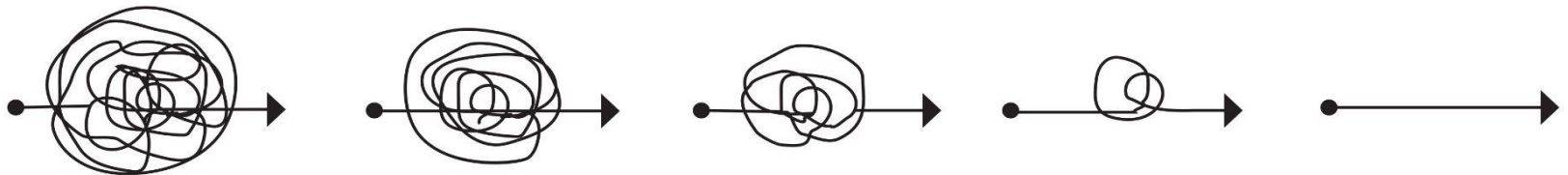## Research-Based Instructional Design Principles and Their Implications

Instructional Design Question

What should these **visual elements look like**, and how can they be **effectively combined with texts** to enhance learning?

Design Process

Human cognition-based approach

➔ Human cognition – information processing model
➔ Cognitive load theory
➔ Cognitive theory of multimodal learning
➔ Research-based instructional design principles
➔ "Building Block Model" chart (adapted from a presentation by
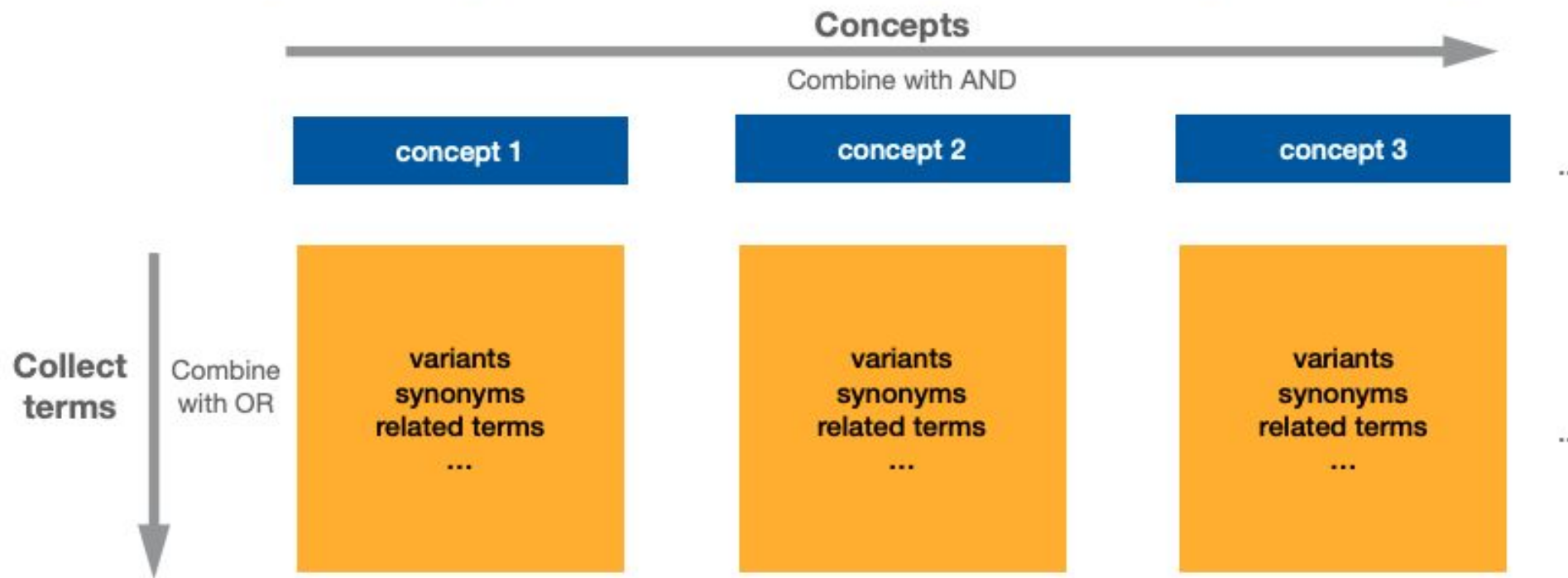KU LEUVEN libraries in Belgium)

Design Outputs

*media.tenor.com

Building block model

Research question/topic: the effect of concept 1 on concept 2 in concept 3

Concepts

Combine with AND

concept 1	concept 2	concept 3

Collect terms — Combine with OR

variants synonyms related terms ...	variants synonyms related terms ...	variants synonyms related terms ...

Design Outputs

★ "Building Block Model" **chart**

★ Three-step **narrated** steps: 1) split research topic into concepts, 2) collect terms for each concept, and 3) combine concepts into a search strategy

★ [Presentation slides](#)

★ [Hands-on practice sheet](#)

*iusgakovsky/Adobe Stock

Pedagogical Approaches

- Active learning
- Scaffolded learning
- Collaborative learning

Discussion & Conclusion

- Initial evidence suggests improved practices aid in knowledge construction and retention.
  - Feedback from instructors, session evals, research consultations
- Further investigations needed for long-term effects.

Thank you for listening! Questions?

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