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

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Engineering and Data Services Librarian
One-Shot Library Instruction
Fall 2023 Stats

Course Level:
- Graduate: 73.91%
- Upper Division: 13.54%
- Lower Division: 4.35%
- 100W: 6.70%

Course Subject:
- Aviation and Technology: 2
- Biomedical Engineering: 4
- Chemical and Materials: 1
- Computer Engineering: 9
- Computer Science: 4
- Design: 1
- Industrial and Systems: 2

Number of students:
- 632

Session meeting format:
- In-person: 47.83%
- Online synchronous: 42.48%
- Online asynchronous: 8.79%
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 can we 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
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)
Constraints of working memory:

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

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

Cognitive Load Theory

Intrinsic Load
(complexity of new information)

Germaine Load
(linking new info with current info)

Extraneous Load
(unnecessary and distracting info)

CLT emphasizes tailored instruction, with novices benefiting more from multimedia

*Adopted from https://www.barefootteflteacher.com/p/what-is-cognitive-load-theory
“People learn better from words and pictures than from words alone”
(Mayer, 2009, p.4)

Mayer’s Cognitive Theory of Multimedia Learning
Cognitive Theory of Multimedia Learning


*Adapted from https://illumina-interactive.com/blog/what-makes-multimedia-learning-so-impactful-revisiting-multimedia-learning-theory-part-1-the-basics/*
<table>
<thead>
<tr>
<th>Principle</th>
<th>Source</th>
<th>Description</th>
<th>Effect Size</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimedia</td>
<td>CTML</td>
<td>People learn better from words and graphics than from words alone</td>
<td>1.39</td>
<td>Utilizing a combination of graphics and narrations to demonstrate the steps involved in constructing a search strategy, particularly beneficial for inexperienced learners</td>
</tr>
<tr>
<td>Expertise Reversal</td>
<td>CLT</td>
<td>Multimedia learning result in better learning outcomes for learners with low prior knowledge than those with higher knowledge levels</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Individual Difference</td>
<td>CTML</td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Modality</td>
<td>CLT &amp;</td>
<td>People learn better from a multimedia message when words are presented in spoken form</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CTML</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporal Contiguity</td>
<td>CTML</td>
<td>People learn better when spoken words are synchronized with corresponding graphics</td>
<td>1.30</td>
<td></td>
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<tr>
<td>Segmenting</td>
<td>CLT &amp;</td>
<td>People learn better when a multimedia message is presented at learner-paced segments rather than a continuous presentation</td>
<td>0.70</td>
<td>Breaking down complexity into distinct steps with clear headings</td>
</tr>
<tr>
<td></td>
<td>CTML</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coherence</td>
<td>CTML</td>
<td>Learning is enhanced when extraneous information is removed</td>
<td>0.70</td>
<td>Exclusively employing graphics and text that directly contribute to the content</td>
</tr>
</tbody>
</table>
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
Building block model

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

Collect terms

Combine with OR

variants
synonyms
related terms
...

Combine with AND

variants
synonyms
related terms
...

variants
synonyms
related terms
...

Adopted from https://istat.kuleuven.be/bijlagen/Library%20info%20session%201%202022-2023.pdf
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](#)
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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