

## Cognitive Load Theory and Instructional Methods

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### Theory Synopsis

The basis of cognitive load theory is that individuals can only process a certain amount information in their working memory, which is the short-term memory a person uses to store and manipulate information while learning. The more a person has to learn in a short amount of time, the more difficult it is to process that information in working memory.

<u>Instructional Method</u>	<u>How to Implement Method</u>
<p style="text-align: center;"><b><u>Chunking</u></b></p> <ul style="list-style-type: none"> <li>• A technique in which information in long-term memory is used to chunk or group together multiple elements of information into a single element that can be easily processed in working memory</li> <li>• Based on the idea that our short-term memory is limited in the number of things it can contain, so we use chunking as a technique to reduce the information to be memorized into seven plus or minus two categories</li> </ul>	<ul style="list-style-type: none"> <li>• Separate individual elements of information into larger blocks, according to their relationship</li> <li>• Example: Concept map, chapters, outlines, phone numbers</li> <li>• 471-1324, not 4-7-1-1-3-2-4</li> </ul> <p>Learn more:  <a href="http://dwb4.unl.edu/Diss/Cooper/UNSW.htm">http://dwb4.unl.edu/Diss/Cooper/UNSW.htm</a></p>
<p style="text-align: center;"><b><u>Split Attention</u></b></p> <ul style="list-style-type: none"> <li>• Source of extraneous cognitive load caused when related instructional elements are separated, even though they must be processed together for understanding.</li> <li>• Results in the learner having to expend mental resources to integrate the two sources of information</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Diagrams</u>: When examples require both text and diagrammatical information to be presented, then the text (as far as possible) should be integrated into the diagram rather than sitting above, below, or beside the diagram</li> <li>• <u>Lecturing</u>: Emphasize important words and provide cues for student note-taking, such as "it should be noted that...". This eases the cognitive load on the learner as they do not have to split their attention between listening and organizing the content</li> </ul> <p>Learn more:  <a href="http://its.sdsu.edu/multimedia/cabinet/index.htm">http://its.sdsu.edu/multimedia/cabinet/index.htm</a></p>
<p style="text-align: center;"><b><u>Worked Examples</u></b></p> <ul style="list-style-type: none"> <li>• A worked example is a step by step demonstration on how to perform a task or how to solve a problem</li> <li>• A worked example can look a lot like a job aid—especially for procedural tasks</li> <li>• Worked examples are natural ways to show specifically how to accomplish some task</li> <li>• Worked examples lower:             <ul style="list-style-type: none"> <li>○ Extraneous cognitive load – the mental burden imposed by the course design</li> <li>○ Intrinsic cognitive load – the inherent difficulty in new instruction</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Worked examples work for both procedural and non-procedural tasks</li> <li>• Best for procedures and processes</li> </ul> <p>Learn more:            Drawing Right Triangles:  <a href="http://mathforum.org/~sarah/hamilton/ham.seeing.triangles.html">http://mathforum.org/~sarah/hamilton/ham.seeing.triangles.html</a></p> <p>Time Dilation - A Worked Example  <a href="http://galileoandeinstein.physics.virginia.edu/lectures/time_dil.html">http://galileoandeinstein.physics.virginia.edu/lectures/time_dil.html</a></p> <p>How To Tie A Tie  <a href="http://www.tie-a-tie.net/fourinhand.html">http://www.tie-a-tie.net/fourinhand.html</a></p>

<b><u>Instructional Method</u></b>	<b><u>How to Implement Method</u></b>
<p style="text-align: center;"><b><u>Backwards Fading</u></b></p> <ul style="list-style-type: none"> <li>Worked examples that transition gradually into practice problems by leaving out an increasing number of steps at the end as learners gain proficiency</li> </ul>	<ul style="list-style-type: none"> <li>Best for novice learners who have built some schema</li> <li>Use in combination with worked examples - leave out an increasing number of steps at the end of example that learners must use their own knowledge to solve</li> </ul> <p>Learn more:  <a href="http://www.scitopics.com/Cognitive_Load_Theory.html">http://www.scitopics.com/Cognitive_Load_Theory.html</a></p>
<p style="text-align: center;"><b><u>Expertise Reversal</u></b></p> <ul style="list-style-type: none"> <li>Negative effect of instructional methods that aid the learning of novices on learning of experts</li> <li>Based on the redundancy effect: Content or expressions that are duplications either of each other or of knowledge already in memory impede learning</li> <li>In some cases, instructional methods such as worked examples interfere with learning of experts because of conflict between the instruction and existing schema of experts</li> <li>Textual/audio explanations of graphics are redundant for experts and thus result in additional unnecessary cognitive load</li> </ul>	<p><u>Prior knowledge is high:</u></p> <ul style="list-style-type: none"> <li>Do not add unnecessary explanations in the form of visuals or text</li> <li>Assign practice exercises rather than worked examples or completion examples</li> <li>Use directive or guided discovery lessons</li> </ul> <p><u>Mixture of low and high prior knowledge:</u></p> <ul style="list-style-type: none"> <li>Use pre-work to bring up novices' knowledge</li> <li>Use adaptive e-learning instruction that caters to the learner</li> <li>Split training into novice &amp; advanced sessions</li> </ul> <p>Learn more:  <a href="http://www.cs.pitt.edu/~chopin/references/tig/kalyuga_ayres.pdf">http://www.cs.pitt.edu/~chopin/references/tig/kalyuga_ayres.pdf</a></p>
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