Principles and effects

This page contains some principles and effects/learning aids researched in frames of cognitive load theory and cognitive theory of multimedia learning.

Principle	Description
Modality principle	Learning will be enhanced if presenting **textual information in an auditory format**, rather than in visual format, when it is accompanied with other visual information like a graph, diagram or animation.[1]
Redundancy principle	Capacity of both human information channels can unnecessarily be **overloaded by redundant information** presented through both channels thereby negatively affecting learning process.[2]
Split-attention effect	"*When each source of information is essential for understanding the represented subject matter, learning improves when multiple sources of information are presented in a spatially and temporally integrated rather than separated format.*"[3] Split attention effect can here be interpreted as *spatial* or *temporal* resulting in spatial and temporal contiguity effect.
Spatial contiguity principle	Information processing is easier when two related visual information **sources are closer to one other**. For example, text placed near the referred place in the diagram will result in more successful learning than if it is placed under the diagram.
Temporal contiguity principle	**Simultaneous presentation** of related information should be most similar to the way human mind operates and has provided good experimental results, same as presenting related multi-modal information with very short time differences.
Coherence principle	(Also called *seductive details effect*) claims that **extraneous material** that may be interesting or motivating but is irrelevant and generally **wastes learning resources**.
Individual differences principle	It emphasizes influence of prior knowledge and cognitive capacity to results of learning. Design effects are stronger for learners with little prior knowledge, and for high-spatial learners who have higher cognitive capacity to mentally integrate verbal and visual information.

Effect	Description	
Signaling effect	(*Signaling* or *cuing*) presents the increase in the learning outcomes due to promotion of attention to relevant information. Signals are based on natural attention attractors like movement or contrast. In multimedia this can also be achieved through underlining, arrows or color-coding.[4]	
Segmenting effect	Learning should be more efficient if a continued animation or narration could be split into more smaller parts.[5]	
Worked examples effect	The reduction in imposed cognitive load due to "*… a step-by-step **demonstration** of how to perform a task or how to solve a problem.*"[6]	
Expertise reversal effect	"*Instructional techniques that are highly effective with inexperienced learners can lose their effectiveness and even have negative consequences when used with more experienced learners.*"[7]	
Explanation prompts	Prompting students to self-explain steps of a worked example or a procedure they're studying has a positive effect on conceptual knowledge.[8]	

Effect	Description
Collective Working-Memory Effect	When the complexity of the material to be learned is low, individual learning is more effective and more efficient than collaborative. For complex materials, collaborative learning is superior since it allows sharing working memory load among participants.[9]
Schema activation	"*Activation and utilization of learners' prior knowledge.*"[10]
Learner control	"*Too much control causes cognitive overload and even experts might experience difficulties in selecting, sequencing and pacing huge amounts of information.*" [11]

1) Ginns, Paul. Meta-analysis of the modality effect. Learning and Instruction 15, no. 4: 313-331. August 2005.

2) For example see: Schmidt-Weigand, Florian, and Katharina Scheiter. The role of spatial descriptions in learning from multimedia. Computers in Human Behavior 27, no. 1: 22-28. January 2011.

3) Florax, Mareike, and Rolf Ploetzner. What contributes to the split-attention effect? The role of text segmentation, picture labelling, and spatial proximity. Learning and Instruction 20, no. 3: 216-224. June 2010.

4) 5) , Visser, R. D. Exploring different instructional designs of a screen-captured video lesson: A mixed methods study of transfer of learning. PhD thesis. Clemson University. 2009.

6) Clark, Ruth Colvin, Frank Nguyen, and John Sweller. Efficiency in learning: evidence-based guidelines to manage cognitive load. John Wiley and Sons, 2006.

7) Kalyuga, Slava, Paul Ayres, Paul Chandler, and John Sweller. The Expertise Reversal Effect. Educational Psychologist 38: 23-31, March 2003.

8) Berthold, Kirsten, Heidi Röder, Daniel Knörzer, Wolfgang Kessler, and Alexander Renkl. The double-edged effects of explanation prompts. Computers in Human Behavior 27, no. 1: 69-75, January 2011.

9) Kirschner, Femke, Fred Paas, and Paul A. Kirschner. Individual Versus Group Learning as a Function of Task Complexity: An Exploration into the Measurement of Group Cognitive Load. In Beyond Knowledge: The Legacy of Competence, edited by Jörg Zumbach, Neil Schwartz, Tina Seufert, and Liesbeth Kester, 21-28. Dordrecht: Springer Netherlands, 2008. cited by Kirschner, Femke, Fred Paas, and Paul A. Kirschner. Superiority of collaborative learning with complex tasks: A research note on an alternative affective explanation. Computers in Human Behavior 27, no. 1: 53-57, January 2011.

10) Kirschner, Paul A., Paul Ayres, and Paul Chandler. Contemporary cognitive load theory research: The good, the bad and the ugly. Computers in Human Behavior 27, no. 1: 99-105, January 2011.

11) Corbalan, Gemma, Liesbeth Kester, and Jeroen J.G. van Merriënboer. Learner-controlled selection of tasks with different surface and structural features: Effects on transfer and efficiency. Computers in Human Behavior 27: 76-81, January 2011. cited by Kirschner, Paul A., Paul Ayres, and Paul Chandler. Contemporary cognitive load theory research: The good, the bad and the ugly. Computers in Human Behavior 27, no. 1: 99-105, January 2011.