2.1 Metaphors of Learning and Cognitive Theory Load in Learning Environments

Findings:

✓ Considering the three metaphors of learning presented in the chapter, how do people learn from e-Courses? (Colvin, & Mayer, 2016), it helps to classify and identify some of the traditional views of learning:

- **Response-Strengthening**, as the first view, contemplates students as “passive recipients of rewards and punishments” (Colvin, & Mayer, 2016, p.34). The main instructional approach of this view is to present questions to learners, to consequently evaluate whether they were right or wrong. The authors suggested that response-strengthening is not at all an erroneous approach. However, this approach “does not explain meaningful learning” (Colvin, & Mayer, 2016, p.34) and ended up on being an incomplete process for the students’ learning.

- **Information-acquisition view of learning** takes place when the learner is seen as only a passive recipient of information. An example of the main instructional approach of this view is the use of only a PowerPoint presentation.

- **Knowledge-construction view of learning** indicates that the learners are not just passive receivers of information, but active participants in their learning. The instructional approach for this learning view is not only to present the information, as the information-acquisition described above but also to encourage and engage the cognitive process in students. The authors indicate that the knowledge-construction view is based on three principles of research in cognitive science (Colvin, & Mayer, 2016, p.35):

  - **Dual channel**: It refers to the type of separate channels that learners have for processing information (visual/pictorial material and auditory/verbal material). As well as called dual-channel assumption in the cognitive theory of multimedia learning, the difference between these two channels can be explained in two conceptual modes:
    
    - **Representation mode approach**: This mode “focuses on the format of the stimulus (i.e., verbal or nonverbal)” (Mayer, 2014, p.48).
    
    - **Sensory modalities**: This mode “focuses on the sensory modality of the stimulus (i.e., auditory or visual)” (Mayer, 2014, p.48).

   The difference of how the two conceptual modes function is related to the way they process printed words. As an example, the authors mention that onscreen text that is on the verbal channel will be initially represented on the representation-mode approach, while the onscreen text that is on the visual channel will be represented on the sensory-modality approach.

- **Limited capacity**: It refers to people that can only handle little information in their working memory. This capacity was expressed in the paper “The magical number seven plus or minus two.”

  - **The magical number seven plus or minus two** by Miller (1994). The similarity of the different experiments is explained in the paper *(see summary in the reference section)*. The author remarks the considerable similarity between them with an average of 2.6
bits (bit is the amount of information that is needed for making a decision between two equal alternatives) that correspond to 6.5 categories.

- **Active processing**: It refers when learners are actively engaged in the learning process, paying attention to the material, organizing information into coherent mental representations and integrating it with their prior knowledge. (Mayer, 2005)

- **Cognitive theory is defined** by Mayer (2014) as a “theory of how people learn from words and pictures, based on the idea that people possess separate channels for processing verbal and visual material (Dual-channel assumption, Limited-Capacity assumption, and active procession assumption).

- **Intrinsic cognitive load**: This is defined by the study as the first category of cognitive load, which is given as a result of the interactivity presence in a learning material or task. It is intrinsic because it requires the working memory to be used. The intrinsic cognitive load is enforced by the interactivity in the learning material (Paas, Renkl, & Sweller, 2003).

- **Extraneous or ineffective cognitive load**: This second category is identified when there is an unnecessary load in learning material, usually when learning procedures were developed without taking into account the structure of the information or the cognitive architecture. (Paas, Renkl, & Sweller, 2003).

- **Germane or effective cognitive load**: This third category is the result of learning materials that are dedicated to acquire schemas and automation. It is influenced by the instructional designers when they required increasing motivation or efforts by the students. The germane cognitive load is indirectly proportional to extraneous cognitive loads; for example, if the instructional design develops an improved learning experience, the extraneous cognitive load is reduced because space in the working memory is freed. However, the germane cognitive load is increased as a result of instructional strategies to improve the learning experience by acquiring advance schemas (Paas, Renkl, & Sweller, 2003).

- **The information store principle**: “Learning is defined as an alteration in long-term memory. If nothing has altered in long-term memory, nothing has been learned.” The “biological secondary information” (Table 1) stores information in the long-term memory that constitutes for someone to have expertise in a subject since this information stores allows experts to recognize most of the situations and actions required in each situation. As a result, the author argues that the information in the long-term memory will determine problem-solving skills (Paas, & Sweller, 2014).

- **The borrowing and reorganizing principle**: “...assumes that we have evolved to acquire information from other people. We imitate what other people do (Bandura, 1986)” (Paas & Sweller, 2014, p.31). This principle affirms that borrowing and reorganizing information allows people to acquire knowledge rapidly and effectively into their secondary biological knowledge. Imitation and listening are classified as primary biological tasks, since they are considered to be innate in humans, and they help to obtain information stored in the biologically secondary knowledge. Other activities, however, as reading falls into a second biologically secondary task since we (humans) do not evolve for to obtain and adapting information through reading, or by using the internet. In summary, this principle suggests that the task and information that is needed for students to engage is highly important (Paas & Sweller, 2014).
✓ **Complex task and working memory:** The students’ cognitive skills will determine when a task is complex. The significance of students’ background knowledge is crucial and should not be ignored. Several processes for testing students’ skill should be planned first, so it will help the students to match and place their prior knowledge with the new information. Addressing dissonances between the prior knowledge and the new information will prevent feelings of discouragement and disengagement (Cevik, & Altunt, 2016).
Table 1: Implications of Cognitive Load Theory

Table 2.1. *Distinctions between biologically primary and secondary knowledge*

<table>
<thead>
<tr>
<th>Biologically primary knowledge</th>
<th>Biologically secondary knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge we have evolved to acquire</td>
<td>Cultural knowledge we have not evolved to acquire</td>
</tr>
<tr>
<td>Modular, with different types of knowledge</td>
<td>Types of knowledge that bear some relation to each other and are acquired in a similar manner</td>
</tr>
<tr>
<td>unrelated to each other and acquired independently at different times and in different ways</td>
<td></td>
</tr>
<tr>
<td>Acquired easily, automatically and unconsciously</td>
<td>Acquired deliberately with conscious effort</td>
</tr>
<tr>
<td>Explicit instruction not required</td>
<td>Best acquired with explicit instruction</td>
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</tbody>
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