Chapter VI
Managing Cognitive Load in Verbal and Pictorial Representations

INTRODUCTION

Chapter VI describes specific evidence-based methods for managing cognitive load in verbal and pictorial information representations. According to the major forms of memory storage, there are verbal and pictorial representational modes, whereas according to major forms of sensory input, there are auditory and visual information modalities. The chapter will consider sources of cognitive load involving different modes and modalities of multimedia information presentations.

When learners process text and visuals that could not be understood in isolation, the process of integrating verbal and pictorial representations is required for comprehension. When text and pictures are not appropriately located close to each other or not synchronized in time, integrating these referring sources of information may increase working memory load and inhibit learning. Instructional design techniques dealing with such split attention situations may enhance learning. Reducing split-attention in paper-based and on-screen text and graphics was one of the first and most commonly mentioned applications of cognitive load theory. Using dual-mode presentations that involve different processing channels of human cognitive system is an alternative approach to dealing with split attention situations.

This chapter discusses means for coordinating verbal and pictorial sources of information in space and time, eliminating redundant components of presentations, segmenting instructional presentations in units that could be processed with

less cognitive load, and other techniques. The chapter also describes interactions between instructional efficiency of different formats of multimedia presentations and levels of learner expertise in specific task domains.

COGNITIVE LOAD IN PICTORIAL REPRESENTATIONS

According to classical work of Larkin and Simon, (1987), an essential advantage of pictorial representations over verbal representations is their capability to provide a more direct access to information. More stimulus features may be represented by pictures in a more compact and cognitively economical and efficient way than by verbal formats. In contrast to verbal information that usually needs to be processed sequentially, visual information is relational in nature and its elements can be encoded simultaneously. According to some recent studies (e.g., Carlson, Chandler, & Sweller, 2003), pictorial representations may reduce cognitive load imposed by intrinsically complex materials (i.e., materials with high levels of element interactivity) compared to the written information. Thus pictorial representations may free required cognitive resources and allow students to redirect these resources to solving complex tasks.

This advantage of pictorial representation has been observed during learning as well as problem solving. For example, Goolkasian (2000) studied the effect of presentation formats on human reasoning processes and showed a consistent advantage of pictures. The advantage was considerable for the acquisition of the externally presented material, however it was much less pronounced when participants were reasoning from material stored in their memory. Problem solving and extracting information from pictured material was quicker than from verbally presented material.

Pictures may also facilitate learning and reasoning because they act as external memory aids that allow freeing up processing resources of working memory (Hegarty & Just. 1993). Together with dual channel processing hypothesis of cognitive theory of multimedia learning (Mayer, 2001) and modality effect of cognitive load theory (Tindall-Ford, Chandler, & Sweller, 1997), these ideas explain why both pictures and spoken words (especially when materials are presented across sensory modalities) have advantage over printed or on-screen words.

Some empirical studies have had difficulties with replicating all predictions of cognitive theory of multimedia learning (Brunken, Plass, & Leutner, 2004; Dutke & Rinck, 2006; Goolkasian, 2000; Lowe, 2003; Moreno & Duran, 2004; Schnotz & Bannert, 2003). The nature of the representations characteristic for different knowledge domains may be essential in predicting the differences in expected results. The studies of R. Mayer and his colleagues in cognitive theory of multi-