Chapter II
Cognitive Load Theory

INTRODUCTION

Cognitive load theory is a learning and instruction theory that describes instructional design implications of human cognitive architecture outlined in the previous chapter. Based on these theoretically and empirically established instructional consequences (usually referred to as cognitive load effects or principles), the theory makes specific prescriptions on managing cognitive load in learning and instruction. The theory distinguishes several different types or sources of cognitive load (e.g., effective and ineffective load; intrinsic, extraneous, and germane load) that are associated with different instructional implications and cognitive load effects. This chapter analyzes cognitive load factors that could potentially influence efficiency of interactive multimedia applications (e.g., levels of element interactivity, spatial and temporal configurations of instructional presentations, redundant representational formats, levels of learner prior experience in a task domain). Basic assumptions of cognitive theory of multimedia learning are discussed. The chapter starts with the description of the sources of cognitive load followed by an overview of the major cognitive load effects.

THE CONCEPT OF COGNITIVE LOAD

Cognitive load could be generally defined as the demand for working memory resources required for achieving goals of specific cognitive activities in certain situations (e.g., instructional episodes or learning tasks). Ideally, these are cognitive resources required for information processing by a specific person (or persons with similar cognitive characteristics) when the individual is fully committed to the task. Thus, cognitive load is a theoretical concept reflecting the interactions between the information structures and learner cognitive characteristics. An actual amount of resources invested in a cognitive activity depends on many factors, including levels of motivation, attitudes, and other personality characteristics.

The actual invested amount of cognitive resources (actual cognitive load) should be distinguished from ideally required resources (required cognitive load). Actual cognitive load can not exceed the amount of ideally required cognitive load. Because of its dependency on multiple factors, the theoretical usability of the concept of actual load is relatively limited at this stage of the development of cognitive load theory and its practical applications. In practice though, this is the load that we usually measure using different cognitive load measurement methods (see Chapter V for an overview). It is assumed that the measured actual load reflects the level of required cognitive load. Therefore, the concept of required ideal cognitive load that is abstracted from many influencing factors (e.g., it implies fully motivated and committed learners) will be the main focus of the following theoretical discussion.

Another important point is that cognitive load is not an objective, depersonalized feature of external information presentations or tasks. It is always related to cognitive processes and characteristics of a specific individual. The word "cognitive" immediately implies relation to individual human cognition. For example, complexity of information (e.g., the level of interactivity between elements of information and even what constitutes an element of information) is always relative to a specific person or a group of learners with similar cognitive characteristics. This issue has become especially important and pronounced in studies of the expertise reversal phenomena (interactions between cognitive load effects and levels of learner expertise in a domain). However, it is equally essential for any other cognitive load phenomena.

ESSENTIAL (EFFECTIVE) COGNITIVE LOAD

There are various sources of cognitive load in multimedia environments. Most obvious ones that we clearly experience when learning complex materials are associated with cognitive activities of establishing key connections between related

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