Chapter III
The Expertise Reversal Effect

INTRODUCTION

Cognitive studies of expertise that were reviewed in Chapter I indicated that prior knowledge is the most important learner characteristic that influences learning processes. Recently, it has been established that learning procedures and techniques that are beneficial for learners with low levels of prior knowledge may become relatively inefficient for more knowledgeable learners due to cognitive activities that consume additional working memory resources. This expertise reversal effect could be related to aptitude-treatment interactions (interactions between learning outcomes of different instructional treatments and student aptitudes) that were actively investigated in 1960-70s. The learner level of prior knowledge or level of expertise is the aptitude of interest in this case. The effect is explained by the cognitive overload that more knowledgeable learners may experience due to processing redundant for these learners instructional components (as compared to information without redundancy). As a consequence, instructional outcomes of different multimedia learning formats and procedures are always relative to levels of learner task-specific expertise.

This chapter describes cognitive processes that cause expertise reversal effect and major instructional implications of this effect. The chapter provides a review of empirical evidence obtained in the original longitudinal studies of the effect, the expertise reversal for methods of enhancing essential cognitive load, and expertise reversal phenomena when learning from textual and hypertextual materials. The chapter also describes relations between the expertise reversal effect and studies of Aptitude-Treatment Interactions. Additional empirical evidence for the effect in other areas will be described in the following chapters in Section 2 of the book.

LEVELS OF EXPERTISE AND IMBALANCES OF EXECUTIVE FUNCTION

As described in Chapter I, long-term memory structures provide executive guidance in performing high-level cognitive tasks. In the absence of such structures, external information may also provide necessary guidance. An executive imbalance occurs when externally provided information conflicts with existing knowledge-based guidance, thus distracting from fluent execution of appropriate cognitive processes. Therefore, well ordered and balanced (optimized) executive function assumes that the external information entering working memory fits and complements available knowledge-based executive structures.

If challenges of the task significantly exceed the available learner knowledge base, the task could cause cognitive overload and anxiety. On the other hand, when these challenges are too low relative to the available knowledge and skills, the task will be easy and boring for the learner. A well fitted task that provides challenges just above the level of learner available experience would provide the best motivating power. Paying unnecessary attention to information that could otherwise be processed automatically and effortlessly would reduce cognitive resources required for other more complex cognitive activities that may indeed require effortful conscious processing in working memory. Such unnecessary diversion of attention may also be a de-motivating factor in learning.

The expertise reversal effect has been initially predicted within the cognitive load theory framework as a form of redundancy effect. This form of redundancy occurs when information that is beneficial for novice learners becomes redundant for more knowledgeable learners due to acquired higher level of expertise in a task domain (Kalyuga, Chandler, & Sweller, 1998). For example, when related text and pictures are separated in space the integration process is expected to increase cognitive load. Physically integrating verbal and pictorial representations may reduce or eliminate this load (split-attention effect). However, for more advanced learners, eliminating non-essential redundant textual explanations was expected to be more effective. For more knowledgeable learners, processing the redundant material (especially if it is embedded into the pictures without the possibility to ignore it) may overload working memory relative to information without redundancy.