# Chapter XI Adapting Levels of Instructional Support to Optimize Learning Complex Cognitive Skills

### INTRODUCTION

This chapter describes some specific adaptive procedures for tailoring levels of instructional guidance to individual levels of learner task-specific expertise to optimize cognitive resources available to learning. Recent studies in expertise reversal effect that were reviewed in previous chapters indicate that instructional design principles that benefit low-knowledge users may disadvantage more experienced ones. This reversal in the relative effectiveness of different instructional methods is due to the increase in cognitive load that is required for integration of presented supporting information with learners' available knowledge structures. The major implication of these findings for multimedia design is the need to tailor levels of instructional support to individual levels of learner task-specific expertise.

The procedures for adapting levels of instructional guidance suggested in this chapter have been developed in conjunction with empirically established interactions between levels of learner expertise and optimal instructional techniques and procedures. The chapter starts with the description of the processes and approaches to learning complex cognitive skills. The appropriate design models for learning complex skills are reviewed and different ways of varying levels of learner control in such models are described. The relations between levels of learner task-specific expertise and optimal levels of instructional guidance are then discussed. Also, empirical studies of the expertise reversal for instructional guidance and sequencing of learning tasks are reviewed. The completion tasks and faded worked examples are specific instructional methods used in the described studies for managing levels of instructional guidance in adaptive learning environments. Real-time monitoring of levels of learner task-specific expertise using rapid cognitive diagnostic methods was used in some of these studies.

### LEARNING COMPLEX COGNITIVE SKILLS

A cognitive-based approach to designing learning environments that aim at achieving students' expert performance in specific task domains distinguishes between the actual expert performance sequence and the sequence of learning tasks. Different instructional procedures could be implemented for learning separate parts of task performance. For example, some skills could be developed first to a high degree of fluency to free limited working memory resources for the following changes in long-term memory knowledge structures. In other cases, general structures of conceptual knowledge could be acquired at the beginning and then elaborated and followed by practice with complex procedures. In this case, a big picture is learned first, followed by more specific knowledge. Moving from a central idea to its elaboration and back results in the acquisition of specific knowledge as part of whole rather than isolated information (Glaser, 1990).

General conceptual models that highlight the major parts, states, and actions in the system as well as the causal relations among them perform an executive guiding role in cognitive processes involved in learning. Such models help learners to build specific mental representations of the system by directing attention toward important information, organizing this information and integrating it with existing knowledge.

However, such externally provided conceptual models should be used cautiously when dealing with more advanced students who already possess well-organized schematic knowledge in the domain. The simplified conceptual models may conflict with these students' more sophisticated knowledge structures and thus inhibit their learning (Mayer, 1989). This phenomenon is directly related to the expertise reversal effect. A cognitive conflict between instruction-based conceptual models and learners' internal knowledge structures may increase processing demands on limited working memory, thus causing the effect. To eliminate such conflicts, instructional design should take into account expert-novice differences and knowledge of processes of cognitive transition from novice to expert states. 24 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: <u>www.igi-</u> <u>global.com/chapter/adapting-levels-instructional-support-</u> optimize/25740

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