SUMMARY OF SECTION III

Multimedia learning environments can significantly enhance learning outcomes by integrating knowledge of cognitive processes involved in human information processing with technological capabilities. Such integration would allow using the most appropriate content and presentation formats, at the most appropriate time, and in the most cognitively efficient way for each individual user, thus providing truly learner-centered and adaptive environments (Shute & Towle, 2003).

Recent research studies in cognitive load issues in multimedia learning have demonstrated that many suggested multimedia presentation techniques that were highly effective with less knowledgeable learners could lose their effectiveness and even have negative consequences when used with more experienced learners. This expertise reversal effect represents an important phenomenon that provides an insight into the operation of our cognitive system in learning. It has been observed in many studies both within and outside of a cognitive load framework. It has also been supported by previously conducted studies in aptitude-treatment interactions. In practical terms, it provides a valuable guidance for the design of learner-adapted instructional systems.

An important implication of the expertise reversal effect is that multimedia presentation techniques and formats need to be tailored to levels of learner task-specific expertise. Dynamically (in real time) selected multimedia instructional formats and procedures should be optimized for individuals with different levels of expertise. To accomplish this goal, firstly, it is important to understand the cognitive mechanisms that influence efficiency of multimedia learning for individual learners. Secondly, it is necessary to have simple rapid diagnostic measures suitable for real-time on-line evaluation of levels of learner task-specific expertise.

Recent advances in our knowledge of human cognitive architecture, learning processes, and the nature of expertise provide a foundation for understanding changes in mechanisms of processing multimedia information that occur with development of learner expertise in a domain. Also, a rapid diagnostic approach to the assessment of levels of learner task-specific expertise has been developed and tested in several domains. Finally, prototypes of adaptive procedures using rapid diagnostic techniques were applied in adaptive computer-based training packages.

All these developments have created prerequisites for the design of comprehensive theory-based adaptive multimedia learning environments that would be dynamically tailored to changing levels of learner expertise. For example, recent studies in rapid diagnostic assessment methods may offer appropriate real-time tools for the dynamic optimization of multimedia instructional systems. These tools may provide adequate fine-grained measures of levels of expertise with sufficient diagnostic power for learner-tailored instructional procedures. Such techniques
can also be used to improve the accuracy of information about levels of learner expertise required for learner modeling in adaptive multimedia and hypermedia systems. The development of adaptive multimedia learning environments in a whole range of task domains (not only for well-defined tasks in technical areas) would require rapid diagnostic instruments for measuring levels of learner expertise in poorly defined domains.

This final part of the book discussed possible adaptive methodologies that are based on real-time monitoring of learner proficiency in a domain by using rapid cognitive diagnostic methods. Such cognitively-supported adaptive learning environments are expected to be not only instrumental in achieving desired instructional effects, but achieving them efficiently, with optimal expenditures of cognitive resources and instruction time.

An important advantage of the rapid assessment-based adaptive procedures for the design of learner-tailored multimedia environments is their relative simplicity. Such procedures can be implemented with common multimedia authoring tools. They do not require the complex computational modeling and high-level programming expertise that are essential for developing sophisticated intelligent tutoring systems (e.g., systems using production rule-based learner models). These relatively simple adaptive procedures have the potential to enhance performance outcomes in multimedia learning environments, increase levels of competence for each learner and, at the same time, reduce training and diagnostic assessment time.