

# Chapter IV

## Assessment of Task-Specific Expertise

### INTRODUCTION

Main implication of the expertise reversal effect is the need to tailor instructional techniques and procedures to changing levels of learner expertise in a specific task domain. In order to design adaptive procedures capable of tailoring instruction in real-time, it is necessary to have online measures of learner expertise. Such measures should be rapid enough to be used in real time. At the same time, they need to have sufficient diagnostic power to detect different levels of task-specific expertise.

One of the previously mentioned reasons for low practical applicability of the results of studies in Aptitude-Treatment Interactions were inadequate aptitude measures. Most of the assessment methods used in those studies were psychometric instruments designed for selection purposes (e.g., large batteries of aptitude tests based on artificially simplified tasks administered mostly in laboratory conditions). Another suggested reason was unsuitability of those methods for dynamic, real-time applications while learners proceeded through a single learning session.

This chapter describes a rapid diagnostic approach to the assessment of learner task-specific expertise that has been intentionally designed for rapid online application in adaptive learning environments. The method was developed using an analogy to experimental procedures applied in classical studies of chess expertise mentioned in Chapter I. In those studies, realistic board configurations were briefly presented for subsequent replications. With the described diagnostic approach, learners are briefly presented with a problem situation and required to indicate their first solution step in this problem situation or to rapidly verify suggested steps at various stages of a problem solution procedure.

The idea of the method and results of its initial application in several relatively well-defined task domains are presented in this chapter. In the following sections of the book, some other examples of the rapid diagnostic techniques will be provided. Specific applications of the rapid diagnostic approach to the adaptive dynamic selection of learning tasks and multimedia instructional formats that are optimal for learners with different levels of expertise will be considered in Section 3 of the book.

## **ASSESSMENT OF DOMAIN-SPECIFIC KNOWLEDGE**

The research on expertise emphasizes the importance of diagnosing domain-specific knowledge structures. Levels of learner expertise could be best evaluated using interviews and think-aloud protocols. However, these methods are not suitable for real-time, on-line adaptation of multimedia formats to dynamically changing levels of expertise. Traditional educational tests either have limited diagnostic capabilities or are too time-consuming. For example, multiple-choice items usually do not provide information about actual solution steps and strategies used by students. These tests rather measure the ability of students to solve the problems by any means, with the same scores allocated for expert-like knowledge-based solutions as for novice-like search-based (e.g., trial-and-error) results.

There have been attempts to develop specific techniques and assessment tasks for evaluating organized schematic knowledge structures, for example, by requesting students to group presented tasks into clusters on the basis of similarity or to categorize tasks after hearing only part of the text. Different computer-based problem-solving environments were used to assess learners' knowledge and skills (Baker & Mayer, 1999). Other 'exotic' assessment tasks asked students to provide answers to problems when relevant task-specific content words had been replaced by nonsense words, identify which information within problems is necessary and sufficient for solution; or to classify problems in terms of whether the text of each problem provides sufficient, missing or irrelevant information for solution ('text editing') (Low & Over, 1992).

In order to evaluate deep differences in knowledge about concepts due to expertise, concept-explanation tasks were used (Chi, Feltovich, & Glaser, 1981; Van de Wiel, Boshuizen, Schmidt, & Schaper, 1999; Nievelstein, van Gog, Boshuizen, & Prins, *in press*). Concept-explanation tasks require participants to tell everything they know about a concept in a short period of time (usually 2-3 minutes). For example, using this method Boshuizen and Schmidt (1992) and Van de Wiel, Boshuizen, and Schmidt (2000) demonstrated medical experts' 'encapsulation' of lower level concepts under higher level, more abstracted concepts. Both electronic

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