

# Chapter 99

## Challenges to Use Recommender Systems to Enhance Meta-Cognitive Functioning in Online Learners

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### ABSTRACT

*A wealth of research has shown that meta-cognition plays a crucial role in the promotion of effective school learning. In most of the e-learning environment designs, however, meta-cognitive strategies have generally been neglected, and therefore, satisfactory uses of these strategies have rarely been realized. Most learners are not even aware of what they have been studying. If the learning system could automatically guide and intelligently recommend learning activities or strategies to facilitate student monitoring and control of their learning, it would favor and improve their learning process and performance. Unfortunately, nearly no e-learning systems to date have attempted to do so. In this chapter, we first described the need for enhancing meta-cognitive skills in e-learning environment, followed by an outline of major challenges for meta-cognitive activity recommendations. We then proposed to adopt data mining algorithms (i.e., content-based and sequence-based recommendation techniques) to meet the identified issues with a toy example.*

### INTRODUCTION

A wealth of research has shown that meta-cognition plays a crucial role in the promotion of effective school learning and the improvement of ill-structured learning (Loizidou & Koutselini,

2007). We are pursuing a vision of learning in which students constantly engage in effective, efficient and fruitful learning. To achieve this vision, developing meta-cognitive expertise is crucial (White & Frederiksen, 2005) in fostering an individual's awareness of different cognitive, social, emotional, and meta-cognitive capabilities that are needed, knowledge of when and why they

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are useful, as well as development of regulatory skills, such as planning, monitoring, and reflecting.

In most of the e-learning environment designs, however, meta-cognitive strategies have generally been neglected and therefore satisfactory uses of these strategies have rarely been realized. Most learners are not even aware of what they have been studying (Kurt, 2007). Even when students monitor their learning, there is a broad theoretical notion that students experience illusions of competence (Bjork, 1999; Koriart & Bjork, 2005), which leads to inaccurate judgment of their learning progresses and outcomes. For these reasons, learners need to be guided towards reflecting on their learning and improving their cognitive models of expertise. The objectives of this chapter were, thus, to specify major challenges for meta-cognitive activity recommendations in e-learning systems and exemplify how the proposed data mining algorithms meet the identified challenges.

## **BACKGROUND**

Strategic selections among recommended learning resources and strategic processing of the selected materials are captured by the concept of *meta-cognition*. Meta-cognition has been defined as the process of “thinking about thinking” (Flavell, 1976, p 232). It refers to higher-order mental processes involved in learning such as creating learning plans, using appropriate skills and strategies to solve a problem, making estimates of performance, and calibrating the extent of learning (Dunslosky & Thiede, 1998). Examples of meta-cognitive activities are: I am engaging in meta-cognition if I notice that I am having more trouble learning A than B; I realize that this might not be the best way to do this task as I did not see much progress after spending many hours; or it strikes me that I should double check C before deciding to use it to support my argument.

Metacognition involves students’ knowledge about their own cognitive processes and efficient

use of the knowledge to regulate these cognitive processes. Accordingly, researchers distinguish between meta-cognitive knowledge and meta-cognitive regulation (Schraw & Dennison, 1994). The former is comprised of declarative knowledge (knowing which learning strategies work and which ones do not work), procedural knowledge (knowing how to use learning strategies), and conditional knowledge (knowing when and why to use strategies). The latter is more concerned with meta-cognitive monitoring and control, such as planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation of progress and goals. Learners make judgments of their learning to monitor their progress and make conscious decisions about learning tasks and learning strategies to control (regulate) their own learning – how to proceed the task with the material, how well the material meets the goals, when and how to adjust the way the material is being used, and so forth. These two components of meta-cognition are highly correlated with each other, so it is possible that they work in unison to enhance academic performance (Schraw & Dennison, 1994). As Schunk and Zimmerman (2006) noted, “[Meta-cognition] requires that one understands what skills, strategies, and resources are required to complete a task as well as how and when to use those skills and strategies” (p. 360). It relates a learner’s knowledge of personal characteristics, knowledge of the task to be completed and knowledge of the strategies available, to those strategies used to select, execute, monitor and control tasks (Flavell, 1979).

Research studies in the past three decades have documented the significance of metacognition, noting its positive effects on students’ academic and personal development. Researchers have conveyed that metacognition is vital to knowledge construction as students who are able to effectively distinguish information they know and do not know are more likely to review and retain new information (Dunning, Johnson, Ehrlinger, & Kruger, 2003; Dunslosky & Thiede, 1998;

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