Chapter 7
Integrating Individual Differences in Adaptive Educational Systems:
The Unified Learning Style Model Case

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ABSTRACT

The chapter provides an overview of the individual differences that have an impact on the learning process and that are currently integrated in adaptive educational systems (AES). The focus is on one of these human factors in particular, namely learning style, which constitutes a popular source of adaptation in recent AES, but also one of the most controversial. The chapter includes a critical analysis of learning styles and their use in technology-enhanced learning settings, motivating the need for a Unified Learning Style Model (ULSM). This model integrates a carefully selected set of learning preferences extracted from several traditional learning style models, related to perception modality, way of processing and organizing information, as well as motivational and social aspects. The practical applicability of the model is also shown by briefly introducing an adaptive Web-based educational system built on it (called WELSA) and reporting the encouraging experimental results obtained so far. The use of ULSM in the emerging Web 2.0 context is also envisioned, by proposing the addition of a social learning dimension to WELSA.

INTRODUCTION

Learning is a complex and multidimensional process, affected by numerous and interconnected factors. Individual differences (such as cognitive and affective traits) play a significant role in this process, having an important impact on how people learn. Personalized or individualized instruction takes these differences into account, tailoring the teaching methods and learning environment to the specific needs of each learner. This individualized approach was proven to be

DOI: 10.4018/978-1-61350-483-3.ch007

superior to the "one-size-fits-all" approaches, both in traditional learning (Vandewaetere, 2011) as well as in technology-enhanced learning (TEL), in the context of adaptive educational systems (AES) (Mourlas et al., 2009).

This chapter reviews the various individual differences that are currently used in AES, focusing on one human factor in particular, namely learning style. This represents a preferred way of thinking, processing, and understanding information, as well as the manner of using this information in learning and solving problems (Jensen, 2003). Learning style is a controversial issue both in educational psychology and in the field of adaptive educational systems. According to Evans et al. (2010), the domain "is a highly complex one which has recently been the focus of rigor-relevance debates (Coffield et al., 2004; Evans and Sadler-Smith, 2006; Rayner, 2006). There is considerable support for the existence and value of style as a construct (Sternberg, 1996) even though further work is needed to evidence greater impact on practice." (p. 467).

This chapter aims at discussing these controversial aspects regarding learning styles, both in traditional and in technology-enhanced learning settings. Furthermore, we try to address some of the identified criticism issues by proposing a Unified Learning Style Model (ULSM), which synthesizes characteristics from the main models in the literature, providing an integrative taxonomy. More specifically, ULSM integrates learning preferences related to perception modality, way of processing and organizing information, as well as motivational and social aspects. An initial proposal of the ULSM has been introduced in (Popescu et al., 2007). Since then, the model underwent a refining and validation process and was successfully used into practice: an e-learning platform called WELSA (Web-based Educational system with Learning Style Adaptation) was built on it (Popescu, 2009a; Popescu, 2010a; Popescu, 2010b; Popescu et al., 2010). In the current chapter we present the revised version of ULSM, together with a detailed description of each of its components and the traditional models they were inspired from. We argue that ULSM is the best choice for a learning style based adaptive educational system and we discuss its advantages.

The rest of the chapter is structured as follows: first, in section 2, we summarize the individual differences that are currently considered in AES, reviewing several learner model frameworks that have been proposed in the literature. Next, in section 3, we focus on the learning style factor and try to motivate why there is a need for a Unified Learning Style Model. To this end, we start by presenting some theoretical aspects, including definitions of learning styles and their implications for pedagogy. Subsequently, we discuss the most frequently raised criticisms regarding learning style and as a response to these challenges, we introduce our ULSM proposal. In section 4 we show what ULSM is, giving a detailed description of each of its components and outlining its advantages. The next section proves how we can use ULSM in a technology-enhanced learning system (called WELSA) and how efficient it is; we also envision the use of ULSM in the new Web 2.0 context, by proposing the addition of a social learning dimension to WELSA. Finally, the last section contains some conclusions and future research directions.

INDIVIDUAL DIFFERENCES ACCOMMODATED IN AES

Understanding learners and their individual differences is essential for the design of effective e-learning systems. Many studies have already empirically proven that tailoring the learning experience to unique personal requirements can increase the learning achievements (Granic and Nakic, 2010). This is why several authors have tried to summarize and categorize the main individual factors that influence learning and that could be taken into consideration in an AES.