Chapter XI

Diagnosing Students’ Learning Style in an Educational Hypermedia System

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ABSTRACT

Individualizing the learning experience for each student is an important goal for educational systems and accurately modeling the learner is the first step towards attaining this goal. This chapter addresses learner modeling from the point of view of learning styles, an important factor for the efficiency and effectiveness of the learning process. A critical review of existing modeling methods is provided, outlining the specificities and limitations of current learning style based adaptive educational systems (LSAES). The controversy regarding the multitude of partially overlapping learning style models proposed in the literature is addressed, by suggesting the use of a complex of features, each with its own importance and influence (the so called Unified Learning Style Model). An implicit modeling method is introduced, based on analyzing students’ behavioral patterns. The approach is validated experimentally and good precision rates are reported.

INTRODUCTION

Accommodating the individual needs of the learner is an important goal of today’s e-learning, whether it implies disabilities, a different knowledge level, technical experience, cultural background or learning style. This is also one of the advantages of web-based education versus traditional, face-to-face learning: the increased potential of providing individualized learning experiences.

In order to be able to optimize and facilitate students’ interaction with a web-based educational system, one must first decide on the human factors that should be taken into consideration and identify the real needs of the students.

The focus of this chapter is on learning style as the human factor, since it is one of the individual differences that play an important role in learning, according to educational psychologists. Learning style refers to the individual manner in which a person approaches a learning task. For example, some learners prefer graphical representations...
and remember best what they see, others prefer audio materials and remember best what they hear, while others prefer text and remember best what they read. There are students who like to be presented first with the definitions followed by examples, while others prefer abstract concepts to be first illustrated by a concrete, practical case study. Similarly, some students learn easier when confronted with hands-on experiences, while others prefer traditional lectures and need time to think things through. Some students prefer to work in groups, others learn better alone. These are just a few examples of the many different preferences related to perception modality, processing and organizing information, reasoning, social aspects etc, all of which can be included in the learning style concept.

Research on the integration of learning styles in educational hypermedia began relatively recently and only a few systems that attempt to adapt to learning styles have been developed. Consequently, “it still is unclear which aspects of learning styles are worth modeling and what can be done differently for users with different learning styles” (Paredes & Rodriguez, 2004, pp.211). However scientists agree that taking these student characteristics into account can lead to an increased learning performance, greater enjoyment, enhanced motivation and reduced learning time (Kelly & Tangney, 2006). We therefore believe that accommodating learning styles in adaptive educational hypermedia is a worthwhile endeavor.

The first step towards providing adaptivity is selecting a good taxonomy of learning styles. Most of the educational systems developed so far rely on a single learning style model, such as those proposed by (Felder & Silverman, 1988), (Honey & Mumford, 2000), (Biggs, 1987) or (Witkin, 1962). In this chapter we advocate the use of a unified learning style model (ULSM), which integrates characteristics from several models proposed in the literature.

The second step is suggesting a method for identifying the learning style of the student. The traditional diagnosing approach implies having the students fill in a dedicated psychological questionnaire. What we propose in this chapter is an implicit modeling method, which is based on the analysis and interpretation of student behavior in the educational system.

Furthermore we address questions such as: What learning style characteristics should be diagnosed and adapted to? How can we create a quantitative model of complex psychological constructs? What type of information is needed from students’ behavior to identify their learning preferences?

Our approach was applied in a dedicated e-learning platform called WELSA (Web-based Educational system with Learning Style Adaptation). The analysis of the student behavior, together with the diagnosing rules, are implemented in a built-in “Analysis tool”.

We start this chapter by briefly introducing the concept of learning styles. The background section also includes a short review of the methods that have been proposed in the literature for learning style diagnosis: while the majority of the current learning style based adaptive educational systems (LSAES) use dedicated psychological questionnaires for identifying the learning preferences of the students, there are some systems that also use an implicit modeling method, based on analyzing the behavior of the students in the system.

The third section deals with our own approach for implicitly diagnosing student learning preferences included in ULSM. First the ULSM model is succinctly described, next relevant patterns of behavior are associated to each learning preference and finally the learning preferences are identified using a rule-based modeling method.

The approach is validated empirically, with the help of a 71 undergraduate student sample who interacted with our WELSA system. The results of the experiment are evaluated and discussed in section 4.