An Adaptive E-Learning System based on Student’s Learning Styles: An Empirical Study

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ABSTRACT

Personalized e-learning implementation is recognized as one of the most interesting research areas in the distance web-based education. Since the learning style of each learner is different one must fit e-learning with the different needs of learners. This paper presents an approach to integrate learning styles into adaptive e-learning hypermedia. The main objective was to develop a new Adaptive Educational Hypermedia System based on Honey and Mumford learning style model (AEHS-H&M) and assess the effect of adapting educational materials individualized to the student’s learning style. To achieve the main objectives, a case study was developed. An experiment between two groups of students was conducted to evaluate the impact on learning achievement. Inferential statistics were applied to make inferences from the sample data to more general conditions was designed to evaluate the new approach of matching learning materials with learning styles and their influence on student’s learning achievement. The findings support the use of learning styles as guideline for adaptation into the adaptive e-learning hypermedia systems.

KEYWORDS
Adaptive Learning, Honey and Mumford Model, Learning Achievement, Learning Style, Personalization

1. INTRODUCTION

Adaptive educational hypermedia systems try to offer an alternative to the non-individualized approach, by providing various services adapted to the learner profile. So, Web-based adaptive e-learning hypermedia systems aim to provide content that fits the individual learning preferences of students. They reflect characteristics of users in a user model and apply that model to adapt instructional aspects of the system accordingly (Brusilovsky, 1996). In this regard, these systems can be considered an extension of intelligent tutoring systems. Like intelligent tutoring systems Web-based adaptive e-learning hypermedia adapts instruction on a micro-level through identifying individual learner needs and providing instructional prescriptions accordingly (Lee & Park, 2008). These prescriptions can be presentation or navigation support (Brusilovsky, 2001). In addition, these systems not only allow users to initiate their choices of instruction, but also provide them with opportunities to use outer web resources. Thus, they are not “closed corpus systems confined to the program” (Lee & Park, 2008, p. 471). With these capabilities they can be used to avoid the one-size-fits-all approach and to create the optimum online lesson for learners with diverse learning needs (Brown, Cristea, Stewart, & Brailsford, 2005).
A number of adaptive educational hypermedia systems have been developed to support learning style as a source for adaptation. AEC-CS (Triantafillou, Pomportis, & Demetriadis, 2003), INSPIRE (Papanikolaou, Grigoriadou, Kornilakis, & Magoulas, 2003) and ILASH (Bajraktarevic, Hall, & Fullik, 2003) are some of examples that are worth citing. However, most of these systems lack the experimental evaluation to assess their impact on student’s achievement. Most of the attempts in this area are based on their adaptation to the user’s level of knowledge (Stash & De Bra, 2004). Other learning features were taken into account such as background, hyperspace experience, preferences and interests (Brusilovsky, 2001; Popescu et al., 2007). However, little interest was paid to learning styles and their effects on learning achievement. This is despite the fact that learning styles constitute a valuable tool for improving individual learning among the user features (Paredes & Rodriguez, 2002). Statistics revealed that students’ learning style can be considered as significant factor that improves the learning performance in web-based learning or e-learning (Manochehr, 2006).

Because of this lack of experimental studies, we attempt in this research study to answer a clearly defined need namely to assess the contribution of the adaptation of a course based on the learning style of the learner in the context of the self-learning via the Web. This article focuses on the proposal for a set of adaptation rules that will be used to adapt the presentation and navigation of an educational hypermedia, while based on the Honey and Mumford model. The main objectives were to evaluate the new approach of matching learning materials with learning styles and their influence on student’s learning achievement. Inferential statistics were used in the form of independent sample t-test to make inferences from the data to more general conditions.

Consequently, in this paper, we have reformulated the problem by setting the following scientific objectives:

- Adopt the experiential learning theory for the design of a dynamic adaptive hypermedia while determining a learner model and a domain model according to this theory.
- Provide an adaptation based on the learning styles of learners to adapt the presentation of pages and links of a hypermedia course using the sequencing and annotation links (scheduling a link in the cycle of experiential learning and an annotation using icons to give learners an idea on the subject to present, based on the model of Honey and Mumford).
- Provide a general description to describe educational resources appropriate for each stage of experiential learning and for each learning style.
- Determine the adaptation rules for each learning style respecting each phase of experiential learning.
- Provide an evaluation module for learners to assess and test their knowledge levels after learning of a particular chapter from courses tailored to their learning styles.
- Finally, evaluate the performance of our system to validate or invalidate the contribution of learning styles in the adaptation process.

The rest of the paper is structured as follows: the next section gives an overview of adaptive educational systems that focus on the learning style of the learners. Section 3 describes the Honey and Mumford’s learning style model that will be adopted in our research. Next, in section 4, we illustrate the architecture of our system and we introduce our own approach to elaborate the adaptation rules. And in section 6, we evaluate our approach. Finally, conclusion and some future works are presented in section 7.
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