

## Chapter 5

# A Model for an Adaptive Hypermedia Learning System Based on Data Mining Technique

**Mahnane Lamia**

*University of Badji Moktar, Algeria*

**Mohamed Hafidi**

*University of Badji Moktar, Algeria*

### ABSTRACT

*Since the learning style of each learner is different. Adaptive hypermedia learning system (AHLS) must fit different learner's needs. A number of AHLS have been developed to support learning styles as a source for adaptation. However, these systems suffer from several problems, namely: less attention was paid to the relationship between learning styles and learning performance. This paper proposes an AHLS model based on learning styles and learning performance. On one hand, the developed prototype will assist a learner in accessing and using learning resources which are adapted according to his/her personal characteristics (in this case his/her learning style and level of knowledge). On the other hand, it will facilitate the learning content teacher in the creation of appropriate learning objects and their application to suitable pedagogical strategies.*

### INTRODUCTION

Employing data mining techniques in an adaptive hypermedia learning systems has received considerable attention, and recently, data mining techniques have been considered useful for optimizing personal learning (Jung & Graf, 2008; Chang, Hung, & Lin, 2015; Lin, Yeh, Hung, & Chang, 2013; Romero, Ventura, & García, 2008; Romero, Ventura, Zafra, & Bra, 2009).

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There are four types of data mining techniques: classification, association, clustering, and sequential pattern mining. Studies have indicated that the clustering algorithm can distinguish learner seeking strategies and similar help-seeking behaviors among learners in the same learning environment (Vaessen, Prins, & Jeuring, 2014). The most useful patterns have been those obtained using the clustering algorithm (Hartigan & Wong, 1979). Currently, this clustering technique has been widely applied in learning programs across various domains, such as intelligent tutoring systems (Vaessen et al., 2014) and history exams (Rodrigues & Oliveira, 2014). Steinley (2006) used the k-means clustering algorithm to explore the use of different help-seeking strategies, whereby the segments were clustered on selected state transition probabilities. The k-means clustering algorithm uses a centroid to represent the cluster, and thus, it is sensitive to outliers, as a data object with an extremely large value may disrupt the data distribution. This technique has the following strengths:

- It is relatively scalable and has computational efficiency.
- The results, which are presented graphically or with rule expressions, can be easily understood and explained.

Wang, Chatzisarantis, Spray, and Biddle (2002) applied the k-means algorithm to identify subgroups of pupils based on achievement goals and perceived competence. However, learning styles are an integral part of various types of learning systems, and to develop adaptive hypermedia learning systems, data mining technology is combined with learning styles. Students who learn using adaptive hypermedia learning systems significantly have better learning performance (Chen, 2009; Jung & Graf, 2008). Although each learning style has a unique learning process (Graf, Lin, & Kinshuk, 2008; Lau & Yuen, 2010; Ross, Drysdale, & Schulz, 2001), few studies have investigated whether learning styles are associated with learning performance in adaptive hypermedia learning systems. Using a k-means algorithm, this study aims to investigate the relationship between learning styles and learning performance in adaptive hypermedia learning system.

## **LITERATURE REVIEW**

Personal traits play an essential role in adaptive hypermedia learning system, and learning styles involve various types of behavioral features that can be analyzed to provide personalized learning strategies. Personalized learning has received considerable attention, with many researchers considering learning styles when developing educational adaptive systems (Dascalu et al., 2015; Graf & Liu, 2010; Graf, Viola, Leo, & Kinshuk, 2007). Graf et al. (2007) indicated that learning styles are increasingly incorporated into learning systems. Some researchers proposed an adaptive hypermedia system based on student learning styles to enhance student learning using course hypermedia (Carver, Howard, & Lavelle, 1996). Al-Azawei and Badii (2014) demonstrated learning style applied in adaptive learning. Mustafa and Sharif (Mustafa, Y.E.A, & Sharif, S.M., 2011) presented an approach to integrate learning styles into AEHS and assessed the effect of adapting educational materials individualized to the student's learning style. TANGOW (Paredes, P., & Rodriguez, P, 2004) is based on two dimensions of FSLSM (Felder-Silverman Learning Style Model): deductive/ intuitive and sequential/ global. Learners are invited to fill ILS (Index of Learning Styles) assessment when they connect to the system for the first time, the learner's model is initialized accordingly. Afterword, learner's actions are monitored by the system, and if they controvert

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