Chapter 9
OrPAF: an Environment for Adaptive Hypermedia Courses in the Semantic Web Context

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ABSTRACT

Adaptive learning support for learners becomes very important in the context of increasing re-use of resources from heterogeneous and distributed learning repositories. This chapter presents OrPAF, an Adaptive Educational Hypermedia (AEHS) and web-based System which integrates semantic web models and technologies in order to achieve interoperability with e-learning systems. The key feature of OrPAF is the construction of adaptive hypermedia courses: both the course structure and the course content are dynamically generated and adapted to learners. On the one hand, a learning ontology is proposed to describe, at a meta-level, abstract characteristics of an e-learning system. This learning ontology is instantiated to construct learning models: domain model, learner model and pedagogical model. On the other hand, semantic annotations and a semantic relevance measure are proposed to improve the LOM metadata associated to learning resources in order to reuse and share them. The authors tested the prototype on learners in order to evaluate the usability of OrPAF and to determine the conceptual capabilities developed by learners who used it.

INTRODUCTION

A subject of much research interest is in personalizing learning supports in order to reuse and share learning resources from distributed repositories (Nejdl, Wolf, Qu, Decker, Sintek, Naeve, Nilsson, Palmer, & Risch, 2002; Miklos, Neumann, Zdun, & Sintek, 2003; Dolog, Henze, Nejdl, & Sintek, 2004). The personalization of existing learning resources can be a solution to the problem of developing
online courses. However, personalized learning using distributed metadata of learning resources is still an unsolved problem in the e-Learning research area.

Considering the increasing re-use of learning resources from the Web it becomes almost impossible for the learners, experts and course instructors to get an overview of all the available information relevant to their current needs, tasks, roles and goals. And even if they find some materials, which seem suitable, they are not able to assess completely whether the content is entirely appropriate for their goals or current knowledge and cognitive state. For that reason, learning resources retrieved from web repositories must be first subject to a pedagogy engineering work in order to render them reusable in the context of a specific training for specific learners. This engineering work is time and effort consuming in the design step of an e-learning system. To solve this problem, we propose an approach that moves part of this engineering effort from the course instructor/expert to the software system and that delivers an adaptive hypermedia course directly to learners.

In this context we aim to offer personalized course support which generates dynamically, for each learner, an individualized course structure and individualized course content by selecting the most optimal learning topics (e.g., the topic Function in the Algorithmics and Programming Languages domain) and the most relevant learning web resources (e.g., the definition of the topic Function) at any moment. Optimal learning topics and associated relevant learning resources are selected to bring the learner closest to his/her ultimate learning goal. This approach is well suited for individual and autonomous learners taking a self-study distance-learning course. They can be employees in an organization who have various degrees of experience and background knowledge and where employees evolve in a competitive economic environment and requiring lifelong learning.

We propose a learning environment which generates adaptive hypermedia courses and reuses learning resources from distant web repositories, called “Organisateur de Parcours Adaptatifs de Formation” (OrPAF—“Personalized Learning Path Organizer”) (Yessad, Faron, Dieng, & Laskri, 2008). Queried learning resources are already annotated with LOM metadata but are very difficult to reuse automatically because of the semantic lack of LOM metadata. Our work is based on semantic web models, particularly ontologies and semantic annotations, in order to improve the quality of LOM metadata and describe in a standardized way several characteristics of e-learning system (i.e., learning resource, pedagogical strategy, learner model and domain model). The semantic Web for E-Learning (SW-EL) field has shown the greatest activity in this trend with several interesting and recurring practices (Dolog & Nejdl, 2003; Aroyo & Dicheva, 2004; Yessad & Laskri, 2006).

Our aim is to improve learning process efficiency (1) by providing the learner with adaptive learning paths according to his/her level of knowledge, learning goal and time constraints; and (2) by reusing learning resources of different web repositories. On the one hand, an adaptive learning path is constructed on the basis of the conceptual structure of the domain model (e.g., the Algorithmics and Programming Languages domain) and the learner model (e.g., beginner). In the learning environment, the learner is assisted to construct a “correct” representation of a particular domain of knowledge and the learning is self-regulated (Pintrich & Schunk, 2002; Perry, Phillips, & Hutchinson, 2004). For this purpose, we apply filters on the domain model to generate a map of relevant learning topics. We call this map an Adaptive Conceptual Map (ACM). An ACM is automatically generated and displayed to a learner, which takes into account a specific goal, the knowledge and temporal constraints of the learner. An ACM represents an adapted view of the structure of the hypermedia course. On the other hand, learning resources that are queried
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