Chapter VI

A Semantic Web Service Architecture for Learning Object Repositories

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Abstract

The evolution of learning technology standards has resulted in a degree of interoperability across systems that enable the interchange of learning contents and activities. Nonetheless, learning resource metadata does not provide formal computational semantics, which hampers the possibilities to develop technology that automates tasks like learning object selection and negotiation. In this paper, the provision of computational semantics to metadata is addressed from the perspective of the concept of Semantic Web service. An architecture based on the specifications of the WSMO project is described, including the definition of an ontology for learning object metadata, and issues of mediation, all under the perspective of the learning object repository as the central entity in learning object reuse scenarios. The resulting framework serves as a foundation for advanced implementations that consider formal metadata semantics as a mechanism for the automation of tasks related to the interchange of learning objects.
Introduction

Current standardized e-learning systems are centered on the concept of learning object (Wiley, 2001), which can be defined as “a self-standing and reusable unit predisposed to be used in learning activities” (Polsani, 2002). Several interrelated standardization efforts—including the IEEE LTSC, ADL SCORM and the IMS Consortium (Anido et al., 2002)—are devoted to produce and refine specifications oriented to fostering consistency in learning contents and related elements. These specifications currently cover learning object packaging and metadata, sequencing and composition of activities, and the definition of specialized types of learning objects like questionnaires, among other aspects. Nonetheless, these specifications do not provide details about the use of well-known knowledge representations for the sake of automating some processes like selection and composition of learning objects, or adaptation to the user or platform. In addition, the information schemas provided in such specifications are not free of controversial interpretations (Farance, 2003), which seriously hamper the possibility of implementing standardized “intelligent” behaviors. Such situation has lead to consider Semantic Web technology as a promising enhancement for learning object-based technology.

Ontologies are shared knowledge representations that form the basis of the current Semantic Web vision (Berners-Lee, Hendler, & Lassila, 2001) and that are becoming widespread due to the availability of common languages like OWL and associated modeling and development tools (Fensel, 2002). Ontologies have been described elsewhere (Lytras, Tsilira, & Themistocleous, 2003; Stojanovic, Staab, & Studer, 2001; Qin, & Finneran, 2002) as enablers of more flexible and advanced learning systems, but the mere use of Ontologies does not guarantee that consistent functionality will become available in the future, since it is also required an effort of specification about the uses of Ontologies for each particular learning technology scenario. Precise and unambiguous usage specifications for Ontologies in e-learning would eventually result in a higher level of automation in learning systems. But preciseness requires a clear separation of responsibilities for the participants in each scenario, along with concrete, machine-oriented interpretations for metadata elements, that is not the focus of current specification efforts.

Previous work (Sánchez-Alonso, Sicilia, & López-Cobo, 2004) has addressed how Web Service architectures combined with precise metadata descriptions can be used as a framework to specify learning object selection and composition processes, which are an essential part of any approach to automation in this area, pointing out to the appropriateness of using richer frameworks of Web Service description as the Web Service Modeling Ontology (Roman, Lausen, & Keller, 2004). Recent work has begun to explore the mapping of existing learning technology standards to the WSMO framework (López-Cobo, Sicilia, & Arroyo, 2004) in the area of metadata-based selection.

In this chapter, the architecture of a Semantic Web service based learning object repository is described, targeting selection and composition processes as basic scenarios for automation in the field of e-Learning. An ontology based on the LOM specification is used to specify both client goals and diverse offerings, and the surrounding issues of mediation are also explored.
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