Chapter XI

Ontologies and Contracts in the Automation of Learning Object Management Systems

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Abstract

Current standardized e-learning systems are centred on the concept of learning object. Unfortunately, specifications and standards in the field 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. Precise usage specifications for ontologies in e-learning would foster automation in learning systems, but this requires concrete, machine-oriented interpretations for metadata elements. This chapter focuses on ontologies as shared knowledge representations that can be used to obtain enhanced learning object metadata records in order to enable automated or semi-automated consistent processes

inside Learning Management Systems. In particular, two efforts towards enhancing automation are presented: a contractual approach based on pre- and post-conditions, and the so-called process semantic conformance profiles.

Introduction

Current standardized e-learning systems are centred on the concept of learning object (Wiley, 2001), which can be defined as "an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts" (Polsani, 2002). This concept of *learning object* is at the centre of a new instructional design paradigm for Web-based learning—a new paradigm that emphasizes reuse as a quality characteristic of learning contents and activities. Most referenced definitions in the field explicitly include the term reuse, including the abovementioned definition by Polsani or the one provided by Wiley (2001), namely, "any digital resource that can be reused to support learning." At the same time, Polsani's definition and others consistent with it (such as those of Sosteric and Hesemeier [2002] and Hamel and Ryan-Jones [2002]) evidence the necessity of including metadata together with the objects. A metadata instance attached to a given learning object provides information on its contents, which undoubtedly facilitates its reusability.

Several interrelated standardization efforts—including the IEEE, ADL SCORM, and the IMS Consortium (Anido et al., 2002)— are devoted to promoting reuse by producing and refining 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. Regarding metadata, LOM (IEEE LTSC, 2002) represents the most important initiative from the learning object point of view and might be consequently considered a promising step towards the reusability objective.

However, when machine-understandability is required, for example, to build software modules that automatically retrieve and combine learning objects to form higher-level units of instruction, reusability means having precise metadata records that contain detailed usage considerations. In this context, more research is needed to come up with rigorous approaches to metadata annotation, enhancing machine understandability. Nevertheless, current 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" behaviours.

Ontologies are shared knowledge representations that form the basis of the current Semantic Web vision (Berners-Lee, Hendler & Lassila, 2001) and are becoming widespread thanks to the availability of common languages like OWL and associated modelling and development tools (Fensel, 2002). Ontologies have been described

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