Chapter 3
Ontologies in Intelligent Learning Systems

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ABSTRACT

The intelligent learning systems provide a direct customized instruction to the learners without intervention of human tutor on the base of Semantic Web resources. The principal role ontologies play in these systems is as an instrument for modeling learning process, learner, learning objects, and resources. In the chapter, a variety of relationships and conceptualizations of ontologies used in the intelligent learning systems are investigated. The utilization of domain and application ontologies in learning object building and knowledge acquisition is represented. The conceptualization of domain ontologies in e-learning is presented by the upper levels of its taxonomies. Moreover, a method and an algorithm intended for generation of application ontologies of structural learning objects (curriculum, syllabus, topic plan, etc.) are developed. Examples of curriculum and syllabus application ontologies are given. Further these application ontologies are used for structural learning object generation.

INTRODUCTION

Primarily, an *intelligent learning system* (ILS) (called also *intelligent tutoring system*, ITS) is fully adaptive (personalized) e-learning system without human teacher participation. The adaptive e-learning is agent-based, learner-oriented and its best implementation through the resources of the Semantic Web could be achieved. By Stojanovic, Staab, and Studer (2001, p.1177):

In fact, the Semantic Web could be treated as a very suitable platform for the implementation of an e-learning system, because it provides all resources for (e-learning) ontology development, ontology-based annotation of learning materials,

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their composition in learning courses and the (pro) active delivery of the learning materials through e-learning portals.

A general schema of ILS representing the modules and the participants in ILS activities on Figure 1 is given. The ontology engineer builds and supports ontologies necessary for e-learning activities by an application named *ontology editor*. The author creates and supports learning content (courseware) according to own learning strategy and using *authoring system editor* and ontologies. In many cases one might say that "the courseware is constructed by the author simply by identifying the sequence of learning objects references which participate in the courseware" (Atif, Benlamri, & Berri, 2003, p.65). The annotated by metadata and reusable *learning objects*[1] (LO) are archived in a *learning content repository* (*or LO repository*) that is a kind of digital library.

By our investigation (Deliyska, & Manoilov, 2009, p.310) the characteristics of ontology-based e-learning determine necessity of following software agents:

- Pedagogical agent (facilitator or course instructor) helping learning process by determining individual learner path in LO chain according to the author learning strategy;
- Content agent (content selector or LO supplying agent) searching and extracting LOs from the repository and supplying them to the learner;
- Input agent checking learner account and actual learner status in the beginning of each learning session, and;
- Assessment agent evaluating test results and registering them in the learner model database.

Generally, agents are servlets or server-based scripts embedded in user interface. The relationships between ILS agents and ontologies in (Deli-

Figure 1. General schema of intelligent learning system