Educational Ontologies Construction for Personalized Learning on the Web

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Summary. Educational resources available on the Web are invaluable learning objects that should not only be accessible, sharable and informative, but also reusable, constructive, and responsive to various pedagogical aspects. Using "Ontology", the knowledge representation core of the Semantic Web, to organize, personalize, and publish learning resources and to discover, generate and compose learning objects has been widely proposed. In response to the diverse education needs, especially learning on the Web, this chapter addresses the issues and methodologies in the design and construction of education ontology and discusses the necessities of such an education ontology that can help retrieving, organizing, and recommending educational resources for personalized learning. Follow a systematic ontology construction approach, the design and implementation of a Personalized Education Ontology (PEOnto) will demonstrate the flexibilities of ontology usages in performing different education tasks as well as enhancing system extensibilities and exchangeabilities.

1 Introduction and Motivation

The Semantic Web "transforms the Web by providing machine-processable and meaningful descriptions of Web resources" [32]. According to the W3C Semantic Web Activity Group statement, the Semantic Web is an extension of the World Wide Web in which information is given well-defined meaning, better enabling computers, and people to work in

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cooperation. Making the Web content machine understandable, allowing agents and applications to access a variety of heterogeneous resources, processing and integrating the content, and producing added value for the user. Data on the Web must be defined and linked in a way that can be used for more effective discovery, automation, integration, and reuse across various applications. To support and reinforce the functionalities that the Semantic Web promises, Semantic Web researchers are working intensively to develop various markup languages to enhance expressivity and retrieval of relevant resources.

Ontologies play a prominent role on the Semantic Web. They make possible the widespread publication of machine understandable data, opening myriad opportunities for automated information processing. Originally, ontology is a systematic account of existence, studies about the nature of existence. For Artificial Intelligent (AI) systems, when the knowledge of a domain is represented in a declarative formalism, the set of objects that can be represented is called the universe of discourse. This set of objects, and the describable relationships among them, are reflected in the representational vocabulary with which a knowledge-based program represents knowledge. Thus, ontology is a "specification of conceptualization" [26]. For Semantic Web services, ontology was designed and built on top of the Semantic Web, which provided a machine-readable semantic framework. However, just a framework is not sufficient to make sharing easier. Data have to be structured and organized in a semantically meaningful way. OWL, a Web Ontology Language, is a means to fulfill this task.

Automatic understanding and processing of resources on the Internet was accomplished through Semantic Web technology [68]. Underlying the promise, it was wrapped up with RDF and XML authored by W3C to represent knowledge to be presented in a universally accessible platform [73]. XML adds "arbitrary structure to documents without saying what these structures mean" while RDF allows "meaning to be specified between objects on the Web and was intentionally designed as a metadata modeling language" [52]. Combining these technologies, it is expected that, in the near future, "discovery, integration, and use/reuse" [32] of Web resources and automation of tasks [36] could be improved. Figure 1 presents the W3C graphical view of the Semantic Web.

Ontology, as a semantic foundation, provides human readable and machine-processable metadata and establishes the technological basis for the semantic processing of Web information and resources. Ontology, as a scheme, is an alternative way to describe the meaning and relationships of terms. This description helps computer systems use terms more easily, and to decide how to convert between terms through a mapping between the ontologies.