

Chapter 18

Using Ontology for Personalized E-Learning in K-12 Education

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ABSTRACT

This chapter introduces the development of a K-12 education ontology for e-learning environments. It presents design and implementation processes, followed by several recommendations for future directions for ontology development. E-learning environments incorporate the notion of semantic Web-based ontologies into their future directions. Semantic Web uses ontologies to show the interconnectedness in a Web environment. Within the concept of semantic mapping, domain ontology is at the core of intelligent e-learning systems. In order to achieve an ontology for K-12 education, the authors propose a domain-specific ontology PoleONTO (Personalized Ontological Learning Environment) with the emphasis on its development and incorporation into an e-learning environment.

INTRODUCTION

E-learning environments incorporate the notion of semantic Web into their future directions. Semantic Web uses ontologies to show the interconnectedness in a Web environment. Ontologies are being

developed in order to decrease the annotated amount of markup and increase the reliability of using computational (intelligent) agents; consequently, a number of ontologies in a variety of domains are being constructed.

Within the concept of semantic mapping, domain ontology is at the core of intelligent e-learning

DOI: 10.4018/978-1-60566-782-9.ch018

systems. Domain ontologies, explicit formal specifications of the terms in the domain and relations among them (Gruber 1993), cover a common ground vocabulary for researchers and educators who need to share information in a domain. In domain ontology, basic concepts and relations among them are defined and translated into machine-interpretable forms.

In addition to domain-specific ontologies, broad general-purpose ontologies are also being developed. For example, the United Nations Development Program and Dun and Bradstreet collaboratively developed the UNSPSC ontology, which provided a terminology for products and services (i.e., <http://www.unspsc.org>). Similarly, enterprise organizations are modeled through ontologies to design e-commerce systems. The CIM-OSA enterprise models (i.e., <http://cimosa.cnt.pl/Docs/Primer/primer0.htm>), for example, offer representations such as business processes and procedural rule sets. Another example is the TOVE ontology project, which aims at developing a set of integrated ontologies for the modelling of both commercial and public enterprises (i.e., <http://www.eil.utoronto.ca/enterprise-modelling/tove/index.html>).

There are several ontologies being developed in the field of education, as well. EduOnto, for example, is based on the metadata schemes for The Gateway to Educational Materials (<http://www.thegateway.org/>) and its controlled vocabulary. The class types include reusable classes (Person, Organization, and Contact), resource object classes (instructional, informational, research), and vocabulary classes (subject categories and terms) (Qin & Hernandez, 2006). Another ontology is Personalized Education Ontology (PEOnto). PEOnto claims to provide learners relevant learning objects based on their individual needs. In PEOnto, five interrelated educational ontologies (curriculum ontology, subject domain ontology, pedagogy ontology, people ontology, and personalized education agents) are being employed (Fok, 2006). In a recent study, Turksoy (2007) developed

a tool to share and reuse of learning objects created during activity development process. The author claims that by reusing and sharing the learning objects, instructors use their time efficiently when producing new learning objects. Nevertheless, either no ontology currently exists specific to the K-12 education domain or they are based on using layers of learning processes (for example, problem solving, critical thinking, decision making, etc.) and concepts (for example, number, optics, mole, etc.) simultaneously. Therefore, the purpose of this study is to create a K-12 education ontology by extracting learning processes and concepts to be applied in e-learning platforms.

WHY DO WE NEED TO DEVELOP AN ONTOLOGY FOR K-12 EDUCATION?

There are several reasons to develop an ontology for K-12 education. First, *sharing common understanding of the structure of information among people or software agents* is a common goal (Musen, 1992; Gruber, 1993). By developing an ontology, the e-learning platform will be a junction for other e-learning components in the network. Secondly, such *domain ontology will enable reuse of domain knowledge*. For example, each student will be able to access interrelated domains as well as a single domain through semantic relations. Therefore, navigation among the concepts will not be limited to a single domain area. Thirdly, *separating the domain knowledge from the operational knowledge* is another common use of ontologies (McGuinness and Wright, 1998). We can describe an expectation (or standard) in the learning space and implement a learning space independent from the expectations through learning processes and concepts. Finally, while developing a domain ontology, *terms and their specifications are analyzed*, which is extremely valuable when both attempting to reuse existing ontologies and extending them (McGuinness, et. al., 2000).

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