Using Ontology as Scaffolding for Authoring Teaching Materials

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ABSTRACT

This article introduces mathematics ontology as a means of supporting teachers for authoring teaching materials. The purpose of this study is to conduct teachers to author a teaching material by using visualized domain ontology as scaffolding on a Content Repository Management System (CRMS). Although the domain ontology of mathematics at the secondary school level in Taiwan provides structured vocabularies for describing domain content, for those teachers who want to create a knowledge-rich description of domain knowledge, such as required by the “semantic Web, using ontology turns out to provide only part of the knowledge required. In the article, we examine problems related to capturing the learning resources or Learning Objects (LOs) on the CRMS. To construct ontology for a subset of mathematics course descriptions, the representation requirements by Resource Description Framework/Resource Description Framework Schema (RDF/RDFS) was implemented. Furthermore, a Visualized Online Authoring Tool (VOAT) is designed for authoring teaching materials on the Web. Finally, discussion and future research are addressed.

Keywords: content repository management system; ontology; RDF/RDFS; SCORM; visualized online authoring tool

INTRODUCTION

Learning Objects (LOs) (Wiley, 2001) are a promising way to create modules of reusable learning content associated with meta-data (Yang & Tsai, 2002). The high-quality content, composed by LOs, has been proven to be the most important requirement for a successful e-learning activity. However, developing educational resources, such as teaching materials, frequently requires significant efforts from teachers as well as support from a team of skilled professionals. To respond to the stern realities of high development costs and restricted budgets, developing LO repositories offers a robust and sustainable strategy.

LOs in a Content Repository Management System (CRMS), a SCORM-compliant learning object repository, can be used to support effective search mecha-
nisms and provide advantages for teachers and course developers. A digital course is generally presented as hierarchical for flexibility in terms of insertion and deletion. The amount of LOs on CRMS has dramatically increased over time. It raises an issue that a teacher might have trouble dealing with LOs while using keywords or form-based slots to acquire LOs on a CRMS.

Several initiatives are trying to resolve practical difficulties related to reuse of learning object technology. These arise in the indexation and retrieval of material (ARIADNE, 2001); creation of new learning content based on individual learning requirements; or development of standards, specifications and tools (IMS, 2000; LTSC, 2001; ADL, 2002). Stimulated by these initiatives, several computer-based training vendors have implemented their own tools that have begun to provide teachers with a wide range of LOs. To date, however, they still are far away for teachers use in authoring their teaching material, since guiding authoring is not always supported.

In this study, we address the problem of capturing knowledge needed for indexing and retrieving information using highly structured semantic descriptions. Such structured descriptions can be much richer than the traditional “set of terms approach.” In fact, they come nearer to a description in natural language, often considered to be the ideal way of describing and indexing teaching material. In order to circumvent the problems of ambiguity in natural language descriptions and queries, structured descriptions should be limited to a fixed set of predefined structures and a set of closed vocabularies. Ontology has a set of closed terms and relations among those terms for simple inference.

In this paper, we assume that the structured descriptions are created by a human annotator using specialized tools. Two related problems arise in this approach: (1) how can a teacher be supported during processes of authoring teaching materials, and (2) where do domain terms or ontology for filling in a structured description come from? The solution to these problems that we pursue in this paper is to implement mathematics at secondary school level of Taiwan by domain ontology to support rich structured descriptions.

This paper is structured as follows. First, we review literature on various alternative approaches to teaching material indexing and retrieval, and the requirements that they pose on vocabularies. Second, we give a brief description of the methodology of this study. Third, results of this study are demonstrated. Finally, some problems arising in using domain ontology as a conducting strategy are included in the conclusion.

**LITERATURE REVIEW**

In this section, four major issues on learning object retrieval are reviewed: (1) a brief description on the retrieval of LOs, (2) CRMS in e-learning ecology, (3) RDF/RDFS for secondary school mathematics in Taiwan and (4) ontology as scaffolding for authoring teaching material.

**Retrieval of Learning Object**

An LO should have at least one specifiable educational purpose or context and could also be used in different contexts used and reused by different teachers. The biggest difference between an LO and an object is considering learning perspective.

There are several paradigms for retrieval of LO in terms of use (Aroyo, Dicheva, & Cristea, 2002):
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