

A Proposed Structure for Learning Objects Using Ontology for Effective Content Discovery

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Abstract

One of the major challenges in e-learning development is search and discovery of an appropriate learning object among the distributed content repositories. Although SCORM presents some approaches for content reusability, but efficient searching process is a significant problem yet. We need an effective searching mechanism for discovery and access to the required learning resources, to utilize them in our courses. But resource discovery within a heterogeneous collection of resources is a challenging problem. Semantic web has been proposed for resolving problems. Some approaches like ontology were proposed to overcome heterogeneity. Ontology represents a set of concepts within a domain, and also the relationships between those concepts. Therefore, by using ontology for metadata of learning objects, we can enrich the information content of the learning objects, and develop a better search methodology.

In this work, according to our proposed ontology, we consider the structure of the learning materials in three levels: Learning Object, Content Object, and Content Fragment. Content Fragment is a content unit in a most basic form. Navigational elements enable the sequencing of content fragments in a content object. Therefore, the Learning Objects aggregate Content Objects to cover a learning objective. By focus on the structure of the learning materials, different kinds of learning materials were created. By using ontology, for these learning materials a rich metadata were shaped. By means of this kind of learning materials our ontology could be evaluated for effective searching.

Keywords: *E-Learning, Ontology, Metadata, Learning Object, Sharable Content Objects (SCO)*

1 Introduction

Using new learning methods is one of the main challenges. One of the methods having more emphasis on the speed of learning process and its customization is E-Learning. For facilitating the construction of knowledge and skills in the learner, learning activities should be aimed (Allison et al, 2005). One of the E-Learning goals is wide access to learning resources with higher quality and lower cost. Information technology has an important role to achieve E-Learning objectives.

In order to improve access methods to educational information, different standards were created such as LOM and Dublin Core. The SCORM standard was created for

reusability of learning contents and better management of learning resources. The existing deficiencies of these standards lead to use semantic web and its technologies for effective learning. Semantic web mainly focuses on giving a well-defined meaning to resources, services, and information. It provides tools for knowledge representation and management, annotation of data and resources, discovery of services and resources based on their meaning and function, automatic composition of services, and inference over metadata and ontologies (Allison et al, 2005). For applying semantic web it is necessary to use ontology to describe resources and applications on the web. Therefore, rich metadata could be available by using ontology.

Using ontology, different projects have been developed in E-Learning domain. The CoAKTinG project (Page, 2005) was developed to advance the state of the art in collaborative mediated spaces for distributed e-Science through the novel application of advanced knowledge technologies. The OntoEdu project (Guangzuo et al, 2004) puts its emphasis on adaptability and personalization in learning by means of ontology. The EUME Onto (Amorim et al, 2004) is an educational ontology that contains concepts of learning design, learning contents and learning resources. Weihong proposed an Integrated Semantic E-Learning Platform. This platform is an approach to integrate content provision, learning process, and learner personality (Weihong et al, 2006). The other paper presented a domain ontology which is used for sharing content and services between repositories (Xin-juan et al, 2007).

The rest of this paper is organized as follows: first, we show the overview of SCORM standard, and Semantic Web, to establish necessary fundamental for the rest of the paper. In section 4, we describe ontology and introduce some parts of our ontology in detail. Section 5 shows the process of creating learning objects which could be used with the proposed ontology. In section 6 we sketch out future works. Finally, in the last section the conclusion is provided.

2 SCORM Standard

Learning object is a small single unit of information that at least covers a single learning objective. Learning objects are sharable and could be reused in different courses. Each learning object contains a variety of information, but they need a standard interface for communication and combination with other learning objects to compose an e-course. SCORM presents a mechanism for share-ability and reusability of learning objects, known as Sharable Content Objects (SCO's) (Ostyn, 2007). Therefore, SCO's could be used to make different courses, reducing time and cost of content development, and could be delivered by different LMS's (Yang and Ho, 2005).

"The SCORM was created by the Advanced Distributed Learning initiative (ADL), and considers six key requirements: Accessibility, Adaptability, Affordability, Durability, Interoperability, and Reusability" (Mackenzie and Baeni, 2004). The SCORM is actually a set of related documents. There are three main SCORM documents: Content Aggregation Model, Run-Time Environment, and Sequencing and Navigation:

The SCORM Content Aggregation Model (CAM) document deals with the assembly, labelling and packaging of Web-based learning contents. The CAM explains the rules and mechanisms by which individual files can be combined into Sharable Content Objects

(SCOs) and how SCOs can be combined to form Organizations. A Content Package is comprised of two main components: the Manifest file and the physical files. The manifest is an XML file that contains metadata about the package, organization structures that describe the structure of the content, and an inventory of the content resources in the package (Mackenzie and Baeini, 2004).

3 Semantic Web

The semantic web is an extension of the World Wide Web in which content can be expressed semantically, and can be read and used by software agents. By getting semantic to the contents, they could be found, shared and integrated more easily. At its core, the semantic web comprises a philosophy, a set of design principles, and a variety of enabling technologies. Semantic web help us to analyze different types of data including the content, links, and also transactions between people and computers.

The semantic web architecture supports content with formal semantics. Thus, the contents on the web can be discovered and used by automated agents. This will enable them to reason about the web content, and produce an intelligent response to unforeseen situations (Stojanovic et al, 2001). Semantic web consist of different layers and use variety of tools and technologies like XML, RDF, RDF Schema, and OWL (Wikipedia, 2008).

Learning contents beside the main content have some semantic annotation and metadata. Thus using semantic web, finding a desired content could be facilitated. Metadata is structured data which describes the characteristics of the other data. it is used for data management and searching content resources. Metadata provides a common set of tags that can be applied to any content resource. Therefore, contents can be describe, indexed, and searched, as a reusable content (Stojanovic et al, 2001). Therefore, contents can be described, indexed, and searched, as a reusable content.

In the E-Learning community different metadata standards are emerging to describe content resources like RDF, Dublin Core, and LOM (Hodgins and Duval, 2002). Also different communities have developed their own metadata. Because of the variation and heterogeneity, different metadata can not interact with each other. "For creating a common understanding between terms in various metadata, vocabularies can be helpful. From the learner point of view, the most important issues for searching learning materials are" (Stojanovic et al, 2001):

Content: What the learning materials are about.

Context: In which form learning material is presented.

Structure: How a set of learning materials merge and create a learning course.

Therefore, by using ontology in each of the above mentioned issues, both instructors and learners can get efficient results with regard to designing and accessing courses, respectively. Consequently, semantic web can provide suitable platform for searching the desired learning contents. References

4 Ontology

Ontology is a data model that represents a set of concepts within a domain and the relationships between those concepts for representing and describing knowledge.

Ontology suggests a formal description and common understanding of a specific domain, and Ontology generally describes (Wikipedia, 2008):

Individuals: the basic or "ground level" objects

Classes: sets, collections, or types of objects

Attributes: properties, features, or characteristics, or parameters that objects can have and share

Relations: ways that objects can be related to one another

Events: the changing of attributes or relations

For coding ontology, different languages have been created and the most important one is OWL. It is a widespread, expressive language that in terms of the ontology allows the use of external reasoning to compute the consistency of the model, classifying the ontology, query the model and retrieving individuals (Vega-Gorgojo et al, 2006). We use Protégé editor (Protégé website, 2009) to show our ontology (Kardan, 2009). This editor provides a graphical view of classes, and a primary class called "Thing" is the root class of all classes.

"The structure of learning objects was specified in the proposed ontology. In this structure, three elements were identified: Content Fragment, Content Object, and Learning Object. A Content Fragment is a content unit in its most basic form, such as text, image, audio, video, animation, table, chart, and so on. Navigational elements enable the sequencing of content fragments in a content object. Content Objects consist of some Learning Objects which cover a learning objective. These elements appear as classes in the proposed ontology" (Kardan, 2009).

As mentioned in section 2, SCORM presents a mechanism for share-ability and reusability of learning objects, known as Sharable Content Objects (SCO's). For implementation and evaluation of our ontology, Sharable Content Objects (SCO) was used as learning objects to attain reusability.

In Figure 1 subclasses of Content Fragment could be seen. A Content Fragment could be text, image, audio, video, animation, table, chart, and so on.

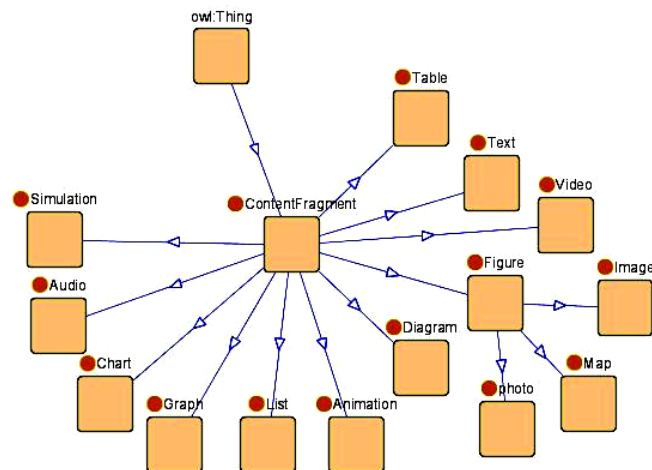


Figure 1. Different Content Fragment

A Content Object represents the content of Learning Object. The contents of an e-course could use examples, questions and answers, exercises, descriptions, lectures, simulations, and so on. As being illustrated in Figure 2, subclasses of Content Object introduce different types of learning resources which are presented in learning e-content. The Learning contents could be delivered to learners in different manners such as Description, Explanation, Example, Exam, Exercise, and Question and Answer.

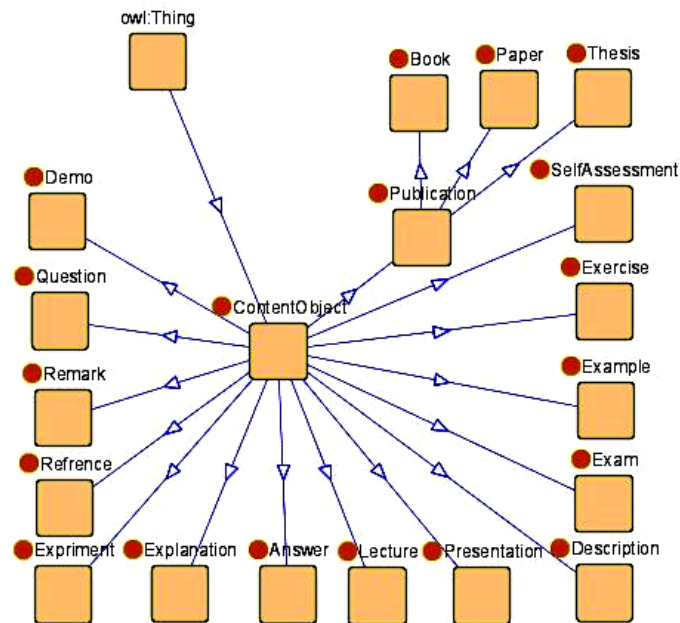


Figure 2. Content Objects

5 Implementation of the Learning Objects

For implementing the proposed ontology, a collection of e-learning contents is necessary. Different concepts of e-learning content domain have been introduced in the proposed ontology. These concepts are used for a set of e-learning contents. Rich metadata for the e-learning contents was created by using these concepts. User can use these concepts and an interface to search variety of e-learning contents on the web.

SCORM standard is an acceptable standard in e-learning contents domain. Most of the learning management systems use SCORM standard to manage e-courses. On the other hand, content designers prefer to create e-learning contents according to SCORM standard. According to the aim of our proposed ontology which is searching the existed contents to reuse them in other course, a set of reusable contents was necessary. Reusability can be guaranteed by using SCORM standard and creating a set of SCO's. The usage of this standard has other advantages. The test and evaluation of the proposed ontology become possible in different learning management systems which are SCORM compatible. Under SCORM definition a learning content could be packed as a Sharable

Content Object (SCO) if it has at least one learning objective. It is mentionable that each SCO includes different files.

To test our proposed ontology, the topic of E-Business and E-Commerce was selected to create an appropriate e-content. In this topic, different issues like E-Commerce Mechanisms, E-Commerce Transactions, Market Research and Online Advertising, and E-Commerce Support Services were introduced.

After selecting a suitable resource for the content, different types of content based on different multimedia capabilities, and according to our ontology were designed and created. The format of the files that being used in the SCO's is not limited by SCORM; so based on unrestricted file's format, a collection of learning contents was produced in Flash and html format.

The structure of learning objects was introduced in our ontology. In this structure, three elements are being identified: Content Fragment, Content Object, and Learning Object.

In this work, a set of Content Objects was created. For the chosen topic we created different types of Content Object like Description, Explanation, Question, Self-assessment, Exercise, Description, Example and Exam. For creating these Content Objects, different kinds of Content Fragments were utilized. Based on our ontology a Content Object is being made of some Content Fragments such as Text, Animation, Table, Video, Image, Audio, and Graph.

We used Flash and html format, because they are capable to support different kinds of Content Fragments. Each of the Flash or html files represent as a Content Object. They include some Content Fragments. The chosen topic is represented in different scenarios. For example in a scenario it is represented in text format and in addition with sound or image. Some of the contents have tree structure for interaction with learner. Video and animation are also used to create parts of the content required for the selected topic. Drag and drop technique also used in questions, exams, and self assessments.

In this work, about 200 files composed as Content Objects were created. They were designed according to the structure of the Learning Objects which are described in our ontology. In next step metadata was created for these files. All of the files and their metadata were put in a content repository. Evaluation of the proposed ontology was done by implementing a semantic search on different repositories

6 Future work

In this paper, considering the proposed structure of learning objects, we recommended a process to create a set of learning objects which can use our ontology to creating metadata. In the next step, using ontology concepts, we create metadata for learning resources. Evaluation of the effect of using this metadata will be done at AELT Group, in Amirkabir University of Technology, by putting these resources in different repositories around the campus, and conducting professors to search for desirable learning objects.

7 Conclusion

The access to the desired content in a collection of them is one of the important challenges in E-Learning domain. Regarding distributed resources, heterogeneity and

lack of universal standard are the main problems. To tackle these problems different solutions have been presented such as creating standards for content development, and semantic web for semantic search.

In this study, the structure of the Learning Object is used for creating Content Objects. This structure was introduced in our previous work (Kardan, 2009). Creating a set of Content Objects is necessary to evaluate the proposed ontology. Therefore, in this work different types of Content Objects including variety of Content Fragments were designed and produced. In the next step it will be shown that metadata could be attached to these Content Objects according to the proposed ontology for implementing a semantic search.

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