Constructing an Ontology for Web-based Learning Resource Repository

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ABSTRACT
Combining the technology of semantic web, this paper constructed an ontology for learning resources repositories and metadata to effectively fulfill knowledge management in web-based learning. Firstly, upper ontology was illustrated according to the functions related learning resource, which included the learning resource repository ontology and the user ontology. Next, the evaluation of ontology was shown. Finally, the metadata was built on Dublin core Metadata Initiative and the IEEE Learning Technologies Standards Committee Learning Object Metadata Working Group. The ontology can manage learning resources and communicate with different users, and it is a solid basis for an architecture where combined online learning system with semantic web.

Categories and Subject Descriptors
I.2.11 [Artificial Intelligence]: Distributed Artificial Intelligence-Intelligent agents; I.2 [Artificial Intelligence]: Miscellaneous; H.3 [Information Storage and Retrieval]: Miscellaneous.

General Terms
Design

Keywords
Ontology, Metadata, Web-based Learning Resource Repository (WLRR)

1. INTRODUCTION
Web has been an important method to learn and acquire knowledge. However, when we would like to seek some necessary learning resource by Google and other search engine on today's web, we often do not get the result we want for high recall, low precision, etc., and it is always reduplicate, tedious and time-costing. The semantic web can be defined as an extension of the current web [1]. The information is regarded as knowledge management with machine-processable, and is used for more effective discovery, automation, integration and reuse across applications.

Dublin Core Metadata Initiative and Learning Object Metadata (LOM) Working Group are metadata standards, which are effective in the description of learning resources. But there are also some disadvantages, such as the lack of reasoning ability and the machine processing ability. The technology of semantic web is a good way to overcome these disadvantages [3]. So, this paper pays more attention to ontology and predominant metadata standards in semantic web as the solution in WLRR.

In the next section, we briefly outlined the function of WLRR, and ontology is designed and evaluated. Section 3 illustrates the metadata structure in detail, and conclusions and remarks on future work concluded this paper.

2. ONTOLOGY DESIGN
2.1 Function and Scope of WLRR
For getting a good description of ontology, the function related to WLRR should be explicit at first. The system users should be registered and allocated different operation rights, such as browse learning resources for all users; download and comment resources, submit and validate learning resource information, record, delete, edit and valid learning resources for corresponding users. And WLRR consists of Exam Problem resource, Case resource, Media resource, Network Courseware resource and Reference resource.

2.2 Building ontology

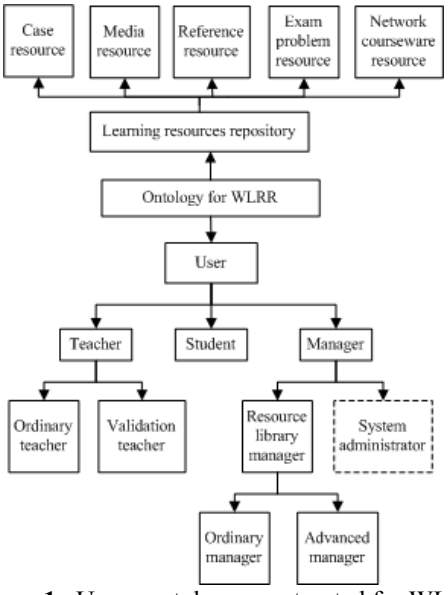

Figure 1. Upper ontology constructed for WLRR

Ontology for WLRR, given in Figure 1, includes two main parts of ontology in WLRR. One is "Learning resources"

ontology concerned the learning resource repository; the other is "User" ontology defined different users.

2.3 Evaluation of Ontology

In order to make a technical judgment of the ontology, their associated software environment, and documentation with respect to a frame of reference. The categorization of the classes in the WLRR evaluation ontology in terms of evaluation methods also provides two methods of analyzing the relationship among the classes. Table 1 shows the function scope for each of the above class when different methods are chosen; Table 2 shows the running status for each class when different evaluation method are chosen.

Table 1. Evaluation method 1 for ontology

Upper class	Student	Ordinary Teacher	Validation Teacher	Ordinary Manager	Advanced Manager
Identity check	√	√	√	√	√
Res. Info. submit	√	√			
Res. Info. validation			√		
Download resource	√	√	√		
Comment resource	√	√			
Browse resource	√	√	√	√	√
Edit resource				√	
Validate resource					√
Resource routines				√	√

Table 2. Evaluation method 2 for ontology

Upper class	class	attribute	variable
Identity check	5	10	10
Resource Info. submit	1	4	7
Resource Info. validation	1	3	6
Download resource	3	3	90
Comment resource	2	2	60
Browse resource	5	5	150
Edit resource	1	3	32
Validate resource	1	2	31
Resource routines	2	2	76

3. METADATA

Metadata is data about data. It creates a new representation where it contains meta-information that usually does not appear in the original resource, that is, metadata about the original information (data). In WLRR, the relation between metadata with ontology is shown in Figure 2. The RDF scheme, class diagrams and some instance are disappeared for the limitation of paper.

Based on the Dublin Core metadata and LOM metadata [2], metadata format in WLRR is indicated as following. It not only controls the whole system, but also expresses education and technology characters.

1) Rights information: A rights management statement, an identifier that links to a rights management statement, or an identifier that links to a service providing information about rights management for the resource.

2) Classification information: A resource classification statement, an identifier that links to subject, keywords for identification of the resource.

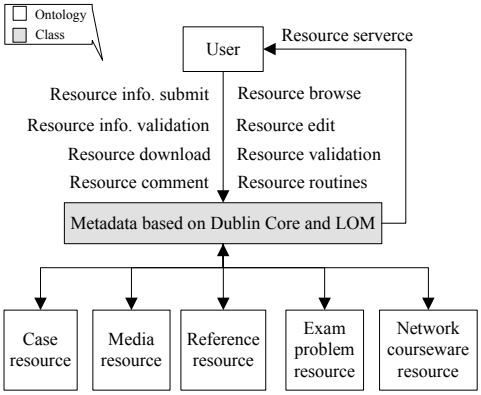

Figure 2. Metadata in WLRR

3) General information: A statement of the content for identifying the resource, classifying and indexing attributes, and it is nothing with the context about the resource.

4) Coverage information: Coverage the spatial and/or temporal characteristics of the intellectual content of the resource. Spatial coverage refers to a physical region using place names. Temporal coverage refers to what the resource is about rather than when it was created or made available.

5) Lifecycle information: Statements of life cycle of the resource, such as version, status, release information, etc.

6) Format information: A textual description of the format of the resource, including data type, class, and or so.

7) Relation information: An identifier of a second resource and its relationship to the present resource. This element is used to express linkages among related resources.

8) Annotation information: Statements of comment and explanation on related resources after applying them.

9) Educational information: Statements for returned improving education after using resource. For sample, interact level, semantic density, difficulty, and or so.

10) Additional information: Statements of cost, price and restriction information about the resource.

4. CONCLUSION

Web-based education with semantic web is very important. This paper built the ontology for WLRR after analyzing the function and evaluation, defined the metadata for WLRR with education and technology factors. Though some instances confirm the validation of ontology, we will further work on constructing practical WLRR's semantic web architecture.

REFERENCE

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