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# **Ontological Organization of Learning Objects Repository for Knowledge Sharing**

**Abstract:** Ontological organization of learning objects for knowledge sharing is investigated. Through three case studies of learning objects repository management systems, theories of ontological organization of learning objects repository for knowledge sharing are developed. Implications of this study for educational institutions, software developers, and learning object repository designers and users are discussed.

**Résumé :** Cette communication présente trois études de cas de systèmes de gestion de dépôts d'objets pédagogiques permettant de développer des théories d'organisation ontologique de ces dépôts aux fins de gestion de la connaissance. Seront discutées les conclusions de cette étude pour les établissements d'enseignement, les concepteurs de logiciel, les concepteurs de dépôt d'objets pédagogiques et leurs utilisateurs.

## **1. Introduction**

A learning object is a unit of digital resource that can be shared to support teaching and learning (Wiley and Edwards, 2002). Along with the proliferation of Web-based teaching management systems such as WebCT as well as e-portfolio systems such as Chalk&Wire, learning objects become increasingly widespread and, at the same time, the management of learning objects repository becomes an important issue.

There have been standards of metadata for learning objects, such as those proposed by Dublin Core (DC, 2010), IEEE LTSC (IEEE LTSC, 2010), and IMS Guide (IMS, 2006). These standards are used to represent individual learning objects at the collection level which is similar to library catalogue systems. However, the use of metadata and keywords to search the needed learning objects is inefficient and ineffective since much potential associations with various learning aspects are bypassed (Mustaro and Silveira, 2006). To use learning objects for knowledge sharing in a specific field, a knowledge structure must be applied to organize the learning objects repository in complex intra-context and inter-context (Wiley, 2000). This has led to approaches to Semantic Web applications that model the relationships between learning objects using formal ontologies (Sicilia and Lytras, 2005).

In this ongoing research project, we investigate ontological organization of learning objects for knowledge sharing. Through a number of case studies of learning objects repository management systems for knowledge sharing, we develop the theories of ontological organization of learning objects repository for knowledge sharing.

## **2. Case Studies of the Ongoing Research Project**

This section provides a summary of the three case studies of our ongoing research project.

### ***2.1. Ontology of learning objects repository for pedagogical knowledge sharing***

This case study discusses the key concepts of ontology of learning objects repository and proposes an ontological model for pedagogical knowledge sharing. The ontological model specifies a generic organizational structure for learning objects repository based on pedagogical design categories. An ontology that actualizes such a structure allows the user of the learning objects repository to play an active role in pedagogical development through searching semantically relevant learning objects. An example of ontology for pedagogical knowledge sharing is used to illustrate the concepts of the development and use of ontologies for learning objects repository.

### ***2.2. E-portfolios for integrated reflection***

E-portfolios have been widely used in the education community. Currently, e-portfolios are viewed mostly as a tool of assessment and showcase, but less as a tool of active learning. This case study proposes an ontological model that specifies a generic organizational structure of e-portfolios in the integrated reflection context. An example of design artifact of ontology of e-portfolios is used to illustrate the concepts of the development and use of e-portfolios for active learning through reflection.

### ***2.3. Domain knowledge in constructing ontology***

The literature of learning objects has suggested that an explicit organizational structure of the repository of learning objects can be an informing layer between the user and the repository to supporting planned teaching and learning. This case study describes how domain knowledge can be used to construct ontologies of learning objects to support designed teaching and learning. The theme of this case study is the design of organizational structures of learning objects through the use of domain knowledge.

## **3. Theories of Ontological Organization of Learning Object Repository**

This section summarizes the theories we have developed through the ongoing research project.

### ***3.1. Ontology represents the semantic relationships between learning objects***

Ontology is a science that studies explicit formal specifications of the terms in the domain and relations among them (Gruber, 1993). In the learning objects field, an ontology is typically a network of semantically related learning objects for a specific learning or instructional domain. An ontology allows people to share common understanding of the subject domain of learning objects. According to Resource Description Framework (RDF) (W3C, 2010), a primitive ontology is a triple containing a subject, an object, and a predicate (relationship). A large ontology for an entire domain is a composition of a set of primitive ontologies. An ontology for a learning objects repository is a network of all related learning objects that shows the semantic relationships between the learning objects.

### ***3.2. Ontology presents the object-oriented vision of learning objects repository***

An ontology of the learning objects repository is an object-oriented model. The premise of object-oriented modeling is that objects are grouped into categories or classes for the application domain. Classes are organized into hierarchies in which the sub-classes inherit properties from their super-class. Inheritance relationships result in static connections between learning objects. In addition to inheritance relationships, the object-oriented paradigm applies message sending from one class to another to make dynamic connections between the classes. These messages accentuate the dynamic relationships between the classes that represent contingent access paths to objects. All static and dynamic relationships between the classes specify the semantic properties of the entire sets of classes. The task of a domain analysis for the construction of an ontology is to actualize classes of learning objects and their semantic relationships.

### ***3.3. Ontology serves as the user-repository interface for the application***

An ontology serves as the user-repository interface that provides views of learning objects in various perspectives to enhance the repository usability for diverse application domains. An ontologies is envisaged as the knowledge structure that fits the application domain. An ontology of the learning objects repository acts as the interface between all users and the learning objects repository to share knowledge.

### ***3.4. Ontology makes metadata more relevant for searching learning objects***

Metadata standards of learning objects intend to generalize taxonomies and vocabularies for learning objects repositories for all disciplines. There is a tacit ontology behind a metadata standard. Such a tacit ontology is too complicated to present because the semantic relationships between all learning objects are hard to be standardized. Tagging all types of metadata and relevant keywords to every learning object could be prohibitively expensive and will eventually make any search engine practically powerless. On the other hand, an ontology of a specific domain for a learning objects repository serves as a map, and suggests paths for retrieving candidate learning objects to reach a certain objective of knowledge sharing. The use of ontology does not exclude the use of metadata. Standardized and domain-specific metadata can be more useful for searching learning objects through ontologies.

## **4. Future Research**

The effectiveness of ontological organization of learning object repository for knowledge sharing must be measurable and assessable. Our future research is to develop measures and models to evaluate the effectiveness of ontological organization of learning objects for knowledge sharing.

## **5. Conclusion**

The competence of learning objects repository depends not only on the abundance of learning objects, but also on the effectiveness of the user-repository interaction. This ongoing research project develops a framework of ontology for learning objects repositories for knowledge sharing. It primarily focuses on the semantic aspects of learning objects repository for knowledge sharing, and has shown the way of support for learning objects in the semantic Web era. It raises new challenges for all parties involved

in learning objects. For educational institutions, there is an organizational need to develop ontologies that contain semantic information about the learning objects repository for various domains. For software developers, new techniques and tools for developing and using ontologies for knowledge sharing are imperative. Simple learning objects repository systems and naive search engines are no longer adequate. In our view, the ontological models proposed in this ongoing research project can practically be used for software development. For the users of learning objects repositories, new skills of information literacy are required. They must clearly understand the knowledge structure of the learning objects repository, and transform unstructured actions to structured tasks by applying the learning objects repository based on their own *a priori* knowledge in order to develop their new knowledge.

## 6. References

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