Including collaborative learning designs in a Learning Object Repository

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Abstract. A learning object repository (or LOR) is presented as a mechanism which facilitates the organisation and reuse of collaborative learning scenarios, using metadata and ontologies. The main design concern here is making it easy for authors and learners to work with the LOR while creating or using learning environments. Three views of the repository are proposed: a reusable storage structure, a dynamic system and an artefact for building collaborative learning environments.

1. Introduction

Learning objects have been defined by a number of authors using different terminology, although essentially referring to encapsulated educational components. Their structure typically includes metadata, educational content or service and, in some cases, information about input and output formats. The expressive power of a learning object management system would be given by its vocabulary, but also by its description and the abstraction levels that its definition makes possible. In order to use the learning objects, a structured container is required. The objects should be stored in such a way as to provide a set of common services which can be realised with them. Facilities are needed for searching, downloading, saving, annotating, indicating relationships between objects, inclusion of events associated with objects, storage of different "versions of the same object", and the provision of some degree of interoperability.

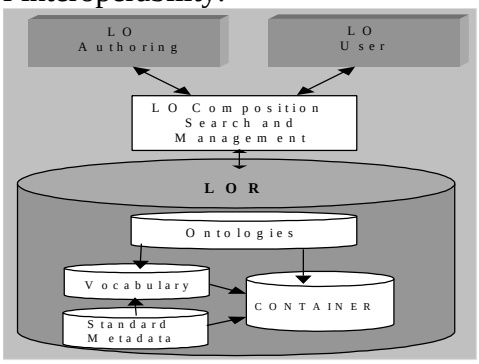

Figure 1. LOR internal architecture

In figure 1, the structure of a Learning Object Repository System (henceforh, LOR) is presented. Compatibility with current standarization efforts is maintained by storing learning objects in a Container together with Standard Metadata [2]. For metadata elements, the recommended vocabularies (in most cases just a list of identifiers) are used. Other concepts, belonging to a number of ontologies, are also included. Ontologies provide a vocabulary to describe entities, classes, properties, predicates, functions, and a set of relationships among vocabulary elements. The Container stores a catalogue of the learning objects currently defined. Ontologies allow the use of semantically aware search engines (an enrichment, in the sense of [3]). Furthermore, this approach would dynamically generate the LOR functionality adapted to the needs of particular learning

communities. Since our main interest lays on collaboration, an important aspect of the LOR is a collaborative learning ontology used to describe the learning objects' definition. All this knowledge is used to generate collaborative learning scenarios, reusing all the objects stored in the container in an efficient manner. Therefore, the LOR has been designed to support Collaborative Learning.

2. Collaborative Learning Scenario Ontology

A Learning Object can be defined as a content-object together with metadata. The basic learning object, or *asset* [2]: "electronic representations of media, text, images, sound, webpages, assessment objects or other pieces of data that can be delivered" either represents the data to be processed by (its input) or resulting from the action of the second type (its output), the *tool*. This type of procedural object requires assets as both input and output. Assets and tools are referred to collectively as *resources*, the definition of which being an abstract specification of their structure, elements, application constraints, and the characteristics of the input and output data, while not including any reference to the executional environment. The next step in this work is the extension of the above definition of learning object to permit more complex combinations. This can be achieved by grouping existing objects together using the *Organization* concept , also considered in the LOM standard. An *Aggregate* is a group of related objects where some sequencing scheme can be associated.

Our proposal of collaborative template addresses a new level: learning design, specifically extending the IMS definition of organizations that of structuring content for individual learning. It can be called a 'template' in the sense of being generic and permitting the resulting combinations to be reused in different scenarios.

Currently, three types of templates have been included in the ontology that derive from the *activity template*. The first is the *Open template*, which means that students, belonging to a learning community, can work together, using a LOR, creating their own learning objects, with a set of tools and norms regarding their use. There is no particular order or predefined plan when undertaking these tasks and they can be carried out at the students' pace. A refinement of this template can be specified in two ways: firstly, as tasks organized in a *workflow template*, focusing on how to organise the subtasks for the group and establishing the division of labour as a workflow; secondly, with the *Structured template*. In this case, planning for the tasks and a declaration of the roles are included. For this purpose, an explicit relationship between task, role and resource is given and some tools are coupled to the tasks.

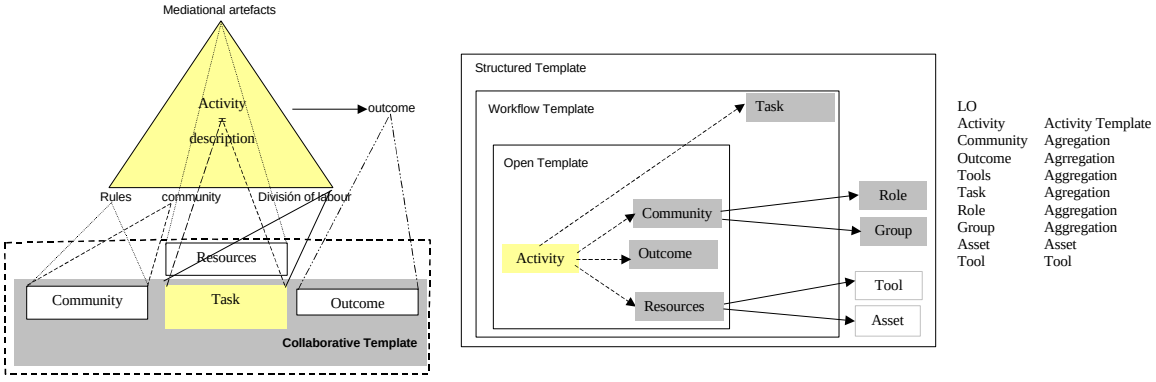

Figure 2. The structure of the Collaborative Template and its relationship with the CSCL ontology

The elements in the Collaborative Template refer to concepts in the CSCL ontology, such as community, role, task, learning object, results or resource [1]. The type of template

will determine which references are used and, therefore, which objects are included in the resulting learning object. The relation between the activity defined by the AT[4] and the template concept can be seen in figure 2. A collaborative scenario is defined by selecting a collaborative template and filling. The contents would vary depending on the template: the open template includes a community, a list of resources and an outcome. The workflow template adds a task definition to the previous one and, finally, the structure template also includes roles, and a relationship between tasks, roles and tools.

3. Views of the Learning Object Repository

The previously defined learning objects can be used according to the scenario needs. In this sense, each way of *using* the learning objects in the repository provides a way to organise collaborative learning scenarios. Hence, the LOR can be seen from three views

(i) A resource provider: The LOR can be seen as a container and manager of resources, i.e., the learning objects, focusing on the way in which they can be referenced, accessed, or distributed. The use of the underlying ontologies extends the LOR capabilities to allow richer searching, querying, retrieving than would be just by using metadata and a plain vocabulary. Thus, the LOR provides an interface that facilitates exploiting the semantic value added by the ontologies.

(ii) An active storage medium: The LOR is also an active storage medium, where the results generated as part of the ongoing activities are saved, and are themselves made available as resources for subsequent activities. This view increases the degree of collaboration because it provides a common mechanism for sharing previously generated data in a flexible and reusable way.

(iii) A mechanism for defining collaborative learning scenarios: The LOR functionality allows contents for instantiating a collaborative template to be retrieved in order to automatically generate learning scenarios customised to a particular domain. The use of the ontologies in the LOR and the object annotation facilitate the author's task in defining a learning environment for a given context. For the structured template case, the **Active Document** (AD) System [5] has been implemented. This system fulfils the role of a 'compiler' generating a distributed environment from the template by managing the references to the learning objects in the LOR. The AD system assembles the definition of a number of learning activities into an operational collaborative scenario. This system has been used to elaborate experimental learning scenarios in the field of Organic Chemistry for supporting laboratory activities in distance learning.

References

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