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Learning Object Annotation for Agricultural Learning Repositories

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Abstract

This paper introduces a Web-based tool that has been developed to facilitate learning object annotation in agricultural learning repositories with IEEE LOM-compliant metadata. More specifically, it presents how an application profile of the IEEE LOM standard has been developed for the description of learning objects on organic agriculture and agroecology. Then, it describes the design and prototype development of the Organic.Edunet repository tool: a Web-based for annotating learning objects on organic agriculture and agroecology, organizing them in using a portfolio-like user interface in a learning repository, and then federating this repository with a network of agricultural learning repositories.

1. Introduction

The use of commonly accepted agricultural metadata schemas aims to make it easier to integrate data from different sources, allowing for creation of value added services for the agricultural sector. A variety of metadata schemas have already been proposed and used in the context of agricultural applications. Efforts are being made to make relevant initiatives around the world to join forces, and to coordinate the further involvement of interested stakeholders. This is the vision of clusters such as the Agricultural Information Management Standards (AIMS, <http://www.fao.org/aims/>) of the Food and Agriculture Organization (FAO) of the United Nations.

An application area that has attracted increased interest by agricultural stakeholders is the one of educational metadata [6]. There have been several interesting approaches regarding

the implementation of educational metadata schemas that will describe learning resources for agricultural stakeholders [8]. A main strand of these approaches includes the ones that are developing application profiles of the IEEE Learning Object Metadata (LOM) standard [5], such as the CG LOM Core [2]. Other approaches have been based on Dublin Core [3], such as FAO's Agricultural Learning Resources application profile (Ag-LR AP) [11].

In this paper, we present the way metadata are being engaged for the annotation of learning resources on organic agriculture, in the context of the Organic.Edunet initiative (<http://www.organic-edunet.eu>). This is a European project that is funded by the eContentplus Programme and involves 15 partners from 10 countries, and which aims to facilitate access, usage and exploitation of digital educational content related to Organic Agriculture (OA) and Agroecology (AE). Learning objects on OA and AE are being deployed in an online federation of multilingual learning repositories, from various content producers. The paper builds upon the semantic federation infrastructure that was presented in Manouselis et al. [7].

2. Metadata Application Profile

The IEEE LOM standard has been chosen as the basis for the metadata application profile to be used in Organic.Edunet. The schema is therefore termed as Organic.Edunet Application Profile (AP). It adopts many of the elements of LOM, specializing several of them in order to better describe learning resources on organic agriculture and agroecology. In each one of the nine (9) categories of LOM elements, a number of elements have been refined, in order to be

used in Organic.Edunet. Table 1 presents how the selected LOM elements have been specialized.

Element	Sub-element	Description	Use in Organic.Edunet	Vocabulary
<i>General</i>	<i>Coverage</i>	The time, culture, geography or region to which this learning object applies.	Include coverage of specific European regions.	LRE Thesauri "160. Countries and Geopolitical Areas"
<i>Meta-Metadate</i>	<i>Contribute. Role</i>	Kind of contribution. Exactly one instance of this data element with value Creator should exist.	Enriched vocabulary containing more values than LOM	Enriched by adopting LREv3.0
<i>Educational</i>	<i>Learning Resource Type</i>	Specific kind of learning object. The most dominant kind shall be first.	Adopted a different vocabulary than LOMv1.0	Adopted from LREv3.0
	<i>Intended End User Role</i>	Principal user(s) for which this DLO was designed, most dominant first.	Enriched vocabulary containing more values than LOM	Adopted from LREv3.0
	<i>Context</i>	The principal environment within which the DLO and use of this DLO is intended to take place.	Enriched vocabulary containing more values than LOM	Adopted from LREv3.0
<i>Rights</i>	<i>Description</i>	Whether copyright or other restrictions apply to the use of this learning object.	Creative Commons (http://www.creativecommons.org) adopted to describe copyrighted material	"x-t-cc-url", " http://creativecommons.org/licenses/by-sa/3.0/ "
<i>Relation</i>	<i>Kind</i>	Nature of the relationship between this learning object and the target learning object	Enriched vocabulary containing more values than LOM	Adopted from LREv3.0
<i>Annotation</i>	<i>Description</i>	The content of the annotation for each element.	Quality certification of each collection collection/provider	"Quality certified from X provider"
			Internal quality review report	Results from internal quality control procedure
<i>Classification</i>	<i>Entry</i>	The textual label of the taxon used.	Classification using the Organic.Edunet ontology	"Organic Farming"; "Fruit production"
			Classification using the AGROVOC Thesaurus (http://www.fao.org/aims/ag_intro.htm)	"Environmental pollution"; "Environmental contamination"
			Classification using the CABI Classification (http://www.cabi.org/DatabaseSearchTools.asp?PID=277)	"environmental science", "animal health"

			Classification using the LRE Microthesaurus on Environment (http://lre.eun.org/node/6)	“environmental education”, “ecology”
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Table 1: LOM elements that have been specialized in the Organic.Edunet AP

3. Repository Management Tool

The Organic.Edunet AP is implemented in a repository management tool that is being used for the organisation and management of Organic.Edunet learning objects: the Organic.Edunet Confolio environment. This is used by the Organic.Edunet content providers to create a digital collection of learning resources, to describe resources with appropriate metadata, and to publish resources in their own learning repository.

The tool allows content providers to connect their repository in the Organic.Edunet federation of repositories. In addition, the tool supports the connection of the repository with other federations of learning repositories. To achieve this, it is built upon open standards and specifications for the exchange of search queries and the harvesting of metadata, such as the Open Access Initiative Protocol for Metadata Harvesting (OAI-PMH, <http://www.openarchives.org>) and the Simple Query Interface (SQI) [12].

3.1. Existing Technologies Reused

Several existing software tools are being - and have been - adapted and integrated for efficient creation, manipulation, and management of learning repositories. The repository tool deals with the way content producers organize, annotate and publish learning objects and metadata in an Organic.Edunet repository. Each of the Organic.Edunet content providers is expected to collect and annotate its learning resources, according to the developed Organic.Edunet AP.

The tools being adapted, reused, and integrated for this purpose are:

1. A configurable metadata editor called *Annotation Tool*, built upon the code-library *SHAME* (<http://shame.sf.net>).
2. The electronic portfolio system *Confolio* (<http://www.confolio.org>) which allows flexible management of folder-based repository interfaces.

3. The *SCAM* (<http://scam.sf.net>) semantic metadata and resource repository.

The Organic.Edunet content providers use an integration of the Annotation Tool and Confolio to upload their resources and the associated metadata into a SCAM repository.

The repository back-end is resource-oriented and stores its metadata according to a Resource Description Framework (RDF) representation of the Organic.Edunet AP. It provides a range of interfaces, allowing the most appropriate to be chosen for each situation. An interface which exposes the repository closest to the internal representation is based on REST (Representational State Transfer) [4], a resource-based software architecture built entirely on top of well established standards such as HTTP.

3.2. Architecture Overview

The core of SCAM is completely built on Semantic Web technologies, in particular the concept of Named Graphs. With Sesame (<http://www.openrdf.org/>), a quad store with support for a variety of storage systems and a powerful API was chosen. The RESTful web services on top of the SCAM core are implemented using the RESTlet framework. To serialize entries and metadata a variety of formats are supported. In addition to the already mentioned RESTful Web services, SCAM also provide mechanisms for harvesting and being harvested using the OAI-PMH and SQI protocols.

Figure 1: The Architecture of the Repository Management Tools

Confolio is an application where the internal types of SCAM are mapped to specific features. There are several different scenarios where Confolio gets a meaningful deployment. It is appropriate as an e-portfolio, but can also be used as plain document and resource management system. It is built on top of the REST API exposed by the SCAM repository and an AJAX (Asynchronous JavaScript and XML, http://javascript.about.com/od/ajax/Asynchronous_Javascript_and_XML.htm) toolkit, which enables cross-browser compatibility and operating-system-independent applications. The basic operations of Confolio can be separated into two groups: administrative (e.g. creation of new portfolios of learning resources) and end-user (e.g. creation of folders and description of resources using the Annotation Tool metadata editor).

The metadata is presented using the AJAX version of Annotation Tool, which is tightly integrated with Confolio, see also the section about metadata presentation and editing. The user interface of Confolio can be configured in several ways. It can be run as a stand-alone application or certain predefined elements (such as the e.g. resource browser) can be embedded into other applications.

3.3. Metadata Presentation and Editing

The metadata are presented and edited using the Annotation Tool code library, a configurable metadata editing framework. This code-library makes it possible to develop flexible and easily extensible annotation tools for handling Semantic Web-based metadata. The Annotation Tool implements a configuration mechanism for

annotation of metadata, which leaves the question of metadata standard-compliance up to a metadata expert - and not to the application developer, which usually is the case. A screenshot of metadata authored using the Organic.Edunet repository tool is presented in Figure 2.

No matter how a resource is added to the system, either by harvesting or by manual input, it should be possible to evaluate its quality. This is done directly in Confolio, where the resource is annotated with additional metadata holding information about the quality, the review, and the validation status. Each reviewer and/or validator has the possibility to assign a status or grade to a resource after having looked at it. According to the results of the review, the resource becomes searchable, harvestable, or is presented to the target group.

Harvested resources already come with some metadata. The resources' harvested metadata can be looked at and extended in Confolio, if necessary. This creates several levels of metadata: the original, harvested metadata, and modifications to this metadata using Confolio, which are kept separately. The same applies to the reviews of a resource as described above. The original metadata are never modified directly. In Organic.Edunet, harvested metadata will be included in repositories with content from the FAO of the United Nations (<http://www.fao.org>), and the Intute repository (<http://www.intute.ac.uk>).

Due to the Semantic Web-based approach of the SCAM repository to support collaborative construction of knowledge artifacts, it is possible to collaborate loosely [13] around metadata annotation. A powerful outcome of this is that a resource can be annotated by multiple users without interfering with each other. In this case the original metadata is not edited directly, instead it is enhanced by an external annotation. This makes it possible e.g. to comment on learning resources without being the owner or even having editing rights for it.

Title*	Best Practice Guide For Organic Apiculture	English
Description*	Guide that provides information about organic apiculture and inparticular about husbandry, nutrition, housing, animal health, welfare breeds.	English
Keyword	apiculture	English
	welfare and breeds	English
	Organic livestock	English
	beehive	English
Structure	Collection	
Contribution		
Role	Author	
Entity	Angeliki Paparadi	
Learning Resource Type	Guide	
Intended End User Role	Learner	
Intended End User Role	Teacher	
Intended End User Role	Counsellor	
Context	Higher education	
Context	Continuing education	
Cost	No cost	

Figure 2: Sample Metadata Section of Organic.Edunet Annotation Tool

4. Current Status

At this stage of development, a first version of the Organic.Edunet repository tool in English has been made public (<http://oe.confolio.org/>). This version of the tool has been used by more than ten (10) content providing organisations in order to annotate more than 600 learning objects on OA & AE. About 300 of the metadata records were harvested by existing sources (i.e. FAO and Intute repositories) and then enhanced by human experts according to the Organic.Edunet AP.

During a period of about six months (September 2008 – February 2009), more than 30 content experts have used the tool and recorded their impressions and observations. In addition, in January 2009 a testing experiment with about 20 participants took place, and more suggestions for improvement have been collected. This feedback has been considered for improvements in the next version of the system that will be deployed in more than ten (10) pilot sites on June 2009.

5. Conclusions

This paper presents the design and first implementation of a Web-based tool for agricultural learning object annotation with LOM-compliant metadata. It first presented an application profile of the IEEE LOM for the description of learning objects on organic agriculture and agroecology. Then, it described a Web-based tool that can be used to annotate such learning objects in learning repositories that are connected in the Organic.Edunet federation of repositories.

This tool builds on the benefits of other similar environments that have been developed so far (e.g. [1, 9, 10]), in order to provide:

- Web-based access to a learning object repository on OA & AE, for more than one content experts of the same provider;
- folder-based portfolio view, for managing and annotating learning objects;
- integrated functionalities for federating with the Organic.Edunet federation, as well as external federations such as ARIADNE and LRE.

The next steps of our work include revising the interface functionalities in order to facilitate the users (e.g. allowing Flickr-like bulk uploading and annotation of learning objects with similar properties). In addition, the integration of a mechanism that will support the quality review workflow that is followed by each repository, and storing the quality review reports in the metadata of the resources. Furthermore, the next version of the repository tool will be multilingual (in more than 9 languages).

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