Learning Object Virtualization Allowing for Learning Object Assessments and Suggestions for Use

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Abstract

Works presented in this paper offer teachers and learners the opportunity to express their learning objects assessments and suggestions for use directly from a learning management system, and to store these annotations within a learning object repository. Annotations are thus stored when and where they become relevant. Thanks to an open and standardized architecture, these annotations can be widely shared and exploited in various contexts such as re-authoring, curriculum designs, or learning object retrieval. Indeed, annotations can represent a basis for a (personalized) quality-based sorting mechanism helping users to find and reuse learning resources that match with their preferences. An implementation focusing on Moodle and the Ariadne Knowledge Pool System validates our approach.

1. Introduction

The Learning Object Metadata (LOM) standard offers an Annotation category in order to “enable educators to share their assessments of learning objects, suggestions for use, etc.” [12]. Annotations are very important: learning object (LO) assessments come to help teachers to build a curriculum whereas LO suggestions for use come to avoid pedagogical mistakes that have been done by others colleagues. This process is essential in a feedback step: during the re-authoring process, peer reviewing and user comments will highlight some crucial points to be improved and related to learning object content, form or description. Naturally, comments submitted by a user and reviews elaborated by an expert don’t have the same significance. Therefore, this paper makes a distinction between these two kinds of assessment.

A learning object and its metadata are often stored in a Learning Object Repository (LOR) in order to facilitate their distribution and reuse. Courseware designers and teachers can thus browse these repositories in order to find existing learning resources matching with the curriculum being built. LO are most often ready for exploitation, and annotations are either not present or not objective because they are provided by LO author(s). Annotations become relevant when a LO has been used, that is after its diffusion within a Learning Management System (LMS): the feedback step comes later than the diffusion step in the learning object and metadata lifecycle [6]. Therefore, LMS are more adapted than LOR to assess a learning object, even if repositories are dedicated to the storage of learning objects metadata.

In this paper, we suggest an approach that offers the opportunity to teachers and learners to submit annotations through a web-based LMS interface, while storing these annotations straight into the matching repository. This functionality is possible thanks to the Learning Object Virtualization (LOV) design [5].

First of all, the main existing systems and standard allowing for LO assessment are presented in order to identify issues that must be solved. To tackle these issues, the next section suggests an annotation framework based on the LOV design and able to transparently share LO assessments suggested by LMS users. We then demonstrate how this open architecture can be successfully implemented using current web technologies. Finally, we conclude before exposing our future works.

2. Learning Object Assessment

Quality represents a growing interest within the research community, as the number of works and tools demonstrates it [8] [11] [19]. We focus our work on peer reviewing and user comments collected during the feedback step. They are only a part of the quality approach and must be considered as a summative evaluation of a ready-to-use LO. Our work also
includes LO suggestions for use that will help teachers building a learning design.

2.1. Existing Reviewing Systems

A system such as MemoNote [3] provides teachers with a personal memory composed of annotations they have made on documents during their various teaching activities. Nevertheless, these annotations are not added into a LOR and cannot be widely shared. On the other hand, Boskic noticed that most of LOR doesn’t support quality evaluation; the others include peer reviews and/or suggest a feature for users’ comments [4]. Table 1 depicts the results of a study related to features provided by five LOR implementing quality evaluations. Qualitative reviews or comments are always present, whereas quantitative reviews (e.g. five-point scales) required for quality-based sorting [22] are not implemented in two repositories. LORI [13], MERLOT [17] and Wisconsin Online [23] distinguish different types of assessor such as subject matter expert, instructional designer, learner, etc., and criteria used for LO evaluation differ from a LOR to another, according to assessor and LO types [15] [20] [22].

<table>
<thead>
<tr>
<th>LOR</th>
<th>Quantitative Review</th>
<th>Qualitative Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evalutech [20]</td>
<td>NO</td>
<td>Peer review by domain expert</td>
</tr>
<tr>
<td>Harvey Project</td>
<td>NO</td>
<td>Peer review + Classroom testing</td>
</tr>
<tr>
<td>LORI [13]</td>
<td>Peer review (4 assessors)</td>
<td></td>
</tr>
<tr>
<td>MERLOT [17]</td>
<td>Peer review (2 domain experts)</td>
<td>Member comments</td>
</tr>
<tr>
<td>Wisconsin Online [23]</td>
<td>Public comments</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. LOR implementing quality evaluations

The following section focuses on the LOM standard, and more especially on the category dedicated to LO assessment.

2.2. The LOM annotation category

The LOM standard offers a whole category to define annotations [12]. A LO annotation is composed of:
- the entity (LOM 8.1) having created the annotation, described using the vCard format,
- the creation date (LOM 8.2) of the annotation, expressed with the DateTime format,
- the description (LOM 8.3) as a LangString.

These descriptors are used within several LOM application profiles, they are mandatory in CanCore [10], recommended in UK LOM Core [21], and optional in many application profiles (SCORM [1], LOM-FR [2]).

An annotation can thus be used to describe learning objects assessments or suggestions for use. Each quantitative and/or qualitative annotation is made at a specific time by an entity (e.g. a user, an organization) matching with a specific type of assessor. Annotations can represent a suggestion for use, may be global to the whole content or specific to a criterion.

2.3 Issues

The two previous sections point out some difficulties that must be solved in order to offer an efficient LO assessment mechanism:
- Despite the need for sharing and reusing this information, most of LOR presented in table 1 store peer reviews, comments and suggestions for use in a specific database, they are not included into metadata;
- Specific web systems have been elaborated to manage assessments, they most often differ from the system used to learn and teach;
- The LOM standard doesn’t take into account neither the role of the entity, nor the type of the annotation (global, specific criterion or suggestion for use). Moreover, the description element (LOM 8.3) is well-adapted for qualitative review but not for a quantitative one.

To tackle these issues, our framework stands on two main proposals: the storage of annotations within metadata and LOR by enhancing the LOM Annotation category structure, and the collection of annotations through a LMS.

3. An open framework for LO Assessment

3.1. The modified LOM Annotation Category

The lacks mentioned in section 2.2 to describe a LOM annotation bring us to propose, as shown on figure 1, several modifications to the Annotation Category:
- the extension of the LOM 8.1 structure in order to get a complete Contribute set that includes an Entity together with its Role,
- the Annotation Type element that specifies whether the annotation is global, related to a specific criterion, or describing a suggestion for use,
- the Quality Level element for providing information about quantitative evaluation.

These enhancements make it possible to fully describe LO assessments using the LOM metadata standard, but a main drawback remains: the difficulty
to collect and store this information. On one hand, few LOR allow users to freely modify metadata (including annotations) of an existing learning object, and LMS are more adapted to LO assessments than LOR on the other hand. Thus, the next section introduces the annotation management service that allows, from a LMS, to add annotations into the metadata of a learning object stored into a LOR.

Figure 1: The modified LOM Annotation category

3.2 Closer to the End User

3.2.1. The Original LOV Design. The LOV architecture [5] is based on learning technology standards and allows for learning objects virtualization: it offers both a single view of the whole set of resources stored into several heterogeneous LOR, and an easy access to those resources through the use of LMS. This framework illustrated on figure 2 offers a transparent communication between LMS and LOR and allows to (a) query the LOR from the LMS and to retrieve learning objects metadata, (b) download the matching documents on the local host, (c) import the matching documents into the dedicated space of the LMS in order to deploy this resource within a learning design, and (d) index new learning objects into a LOR starting from a LMS. Nevertheless, it does not provide any service related to LO assessment.

3.2.2 Annotation Management Service. As illustrated on figure 2, the Annotation Management Service (AMS) has been added into the Federation layer. It allows LMS users to submit annotations and to store these assessments into a LOR. The nature of this service makes it only apply to learning resources imported from a LOR into a courseware. Indeed, resources that have been directly uploaded to the LMS by users are not described with metadata, and can’t be stored into a LOR.

When an assessment is submitted, data specified by the assessor are transmitted through the AMS to the appropriate LOR. In order to make the process smoother, the service allows for automatic metadata generation by exploiting the learning context of the LMS: entity and role are automatically produced.

Figure 2: The improved LOV architecture

The introduction of the AMS into the LOV architecture presents several benefits:
- It allows users to add an annotation when it becomes relevant, that is after the LO exploitation within a LMS.
- It enables various users, distributed on several LMS, to share annotations stored on multiple LOR.
- Criteria used to evaluate a learning object can be customized within the LMS depending on the user role.

Moreover, the storage of annotations within a LOR allows improving the Search Service of the Federation layer. Indeed, a teacher editing a courseware and searching for existing learning objects is now able to consult annotations associated to these resources. It thus helps teachers and tutors to:
- Build a learning design or courseware by improving the learning object selection process: editing teachers can sort learning objects according to a quality-based mechanism that takes into account global or personalized criteria weighs.
- Avoid pedagogical mistakes during the resource exploitation, and to be aware of the specific challenges or strengths undertaken by the resource.

4. Implementation: Moodle and the Ariadne repository

The original LOV architecture has been implemented with two LMS (INES and Moodle), and four LOR (MERLOT, ARIADNE, EDNA and NIME) [5]. The AMS focuses on the cooperation between Moodle [16] and the LOM-based ARIADNE Knowledge Pool System (KPS) [9]: annotations are generated from Moodle and stored within the KPS. Because the M in Moodle stands for modular, the new features presented here have been added to the existing
LOV module for Moodle, and have only required ten development days.

Roles natively defined by Moodle are the followings: administrator, course creator, editing teacher, teacher, student, and guest. The role “subject matter expert” has thus been created in order to allow peer reviews. Fast global quantitative evaluations can be made by users via a graphical star rating system illustrated on figure 3. Detailed evaluations consist in filling in one or several forms that include:

- the annotation type which can be global, matching with a suggestion for use or specific to an evaluation criterion. The first implementation suggests criteria defined by MERLOT: Content Quality, Effectiveness, Ease to Use [15].

- the description of the qualitative evaluation,

- a graphical five-point star rating system related to the annotation type. When the annotation type matches with a suggestion for use, this rating system becomes incongruous and is de facto disabled.

Figure 3: LO evaluations within the LMS

Each user can submit and modify one annotation per annotation type for a same LO. There is no limit to the quantity of users storing annotations for a same LO. Let us note that the Contribute and Date elements of the LOM Annotation category don’t appear on figure 3. Indeed, the entity vCard and the role can be deduced from the LMS profile of the user, whereas the date can be easily calculated.

Annotations submitted by users are transparently stored within the KPS. The UML diagram sequence illustrated on figure 4 represents the required operations to achieve this process:

1. A user submits an annotation through the Moodle interface.
2. Moodle delivers the annotation to the AMS.
3. This last generates the vCard and role of the user by querying the Moodle database, and consults the LO properties in order to extract the location of the LOR responsible for its management, together with its matching identifier. Those properties are specified by the Importation Service (see figure 2) during the importation process: it keeps the relationship between the target LOR, the LO and its identifier within the LOR.
4. The AMS sends both the annotation and the LO identifier to the Ariadne Web Services (AWS) responsible for managing the repository. The SOAP protocol is used to ensure communications between these entities.
5. The AWS add the annotation to the metadata item describing the matching learning object.

Figure 4: Annotation submission sequence

The AMS has just been developed and is now deployed within the International E-Miage (IEM) learning environment, a digital campus that delivers degrees to French and foreign lifelong learning students [7]. All experts, tutors, and learners located in the various IEM exploitation centers are thus able to submit their own annotations, and to benefit from assessments suggested by the whole community. First results will be collected at the end of the semester and will help us to enhance the AMS to fulfill users’ requirements. The source code will then be available on the ARIADNE web site.

5. Conclusion and Perspectives

We presented in this paper an open architecture that facilitates learning objects assessments and suggestions for use. This framework allows users to submit annotations directly from a LMS, and to store these annotations into a LOR for share and reuse purposes. Thus, annotations are submitted and retrieved when and where they become relevant. They can come from various LOR and be used in multiple LMS.

The Annotation Management Service has been successfully implemented for a specific LMS communicating with a LOR, and has just been deployed within the various exploitation centers of an international digital campus. In order to widely benefit from this work, both the modifications applied to the Annotation Category of the LOM standard and the vocabulary used for roles, annotation types and quality levels should be adopted by consensus. Other metadata standards such as ISO MLR are being elaborated; a proposal will be suggested in this direction. However, success and efficiency of learning objects assessments
strongly depend on end users’ motivation and involvement; the huge number of MERLOT statistics about peer reviewing and user comments makes us confident about this approach.

The vocabulary of annotation types should automatically be adapted to the user role: a subject matter expert should fill in each criterion of a peer review, whereas other actors may submit global evaluations. This would allow to improve the LO selection process by attributing different weights to each criterion. Moreover, it should also be useful to customize evaluation criterion according to the learning object type: a slide is not annotated and evaluated as if it were an experiment. Some specific criteria should thus be defined for each existing type of learning object.

Some systems allow annotations to be made forthright on documents by teachers or students during their various pedagogical activities. As future works, we plan to consider in situ annotations in order to encourage users to generate annotations. Indeed, time is needed to consider a learning object from a higher point of view and to conceive a general annotation, whereas an annotation related to a specific image or point of view and to conceive a general annotation, is needed to consider a learning object from a higher pedagogical activity. As future works, we plan to consider in situ annotations in order to encourage users to generate annotations. Indeed, time is needed to consider a learning object from a higher point of view.

Finally, we want to investigate deeper the opportunity to offer to end-users a personal annotation feature. Indeed, some annotations make only sense for their author (e.g. “not understood, should go over the basics”), whereas some others have to be shared with the whole community.

6. References