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Learning objects evaluation

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Web development is promoting important advantages for educational area specially e-learning systems. learning objects (LOs) aim to reuse specific information though different context and platforms. However, an important issue to define is to guarantee the LOs quality content. To evaluate LOs in a first place we propose our own LOs definition. According to this, we suggest to relate LOs metadata information with quality criteria. To promote a better reliability results we suggest to consider experts and users participation.

Keywords learning objects, e-learning, quality

La evolución de la Web está promoviendo importantes ventajas para el área educativa, especialmente para sistema *e-learning*. Los objetos de aprendizaje permiten reutilizar información específica a través de diferentes contextos y plataformas. Sin embargo, un importante asunto por definir es la calidad del contenido de los objetos. Para evaluar los objetos, en primer lugar proponemos nuestra propia definición de objetos de aprendizaje. De acuerdo a esto, sugerimos relacionar metadatos de los objetos con criterios de calidad. Para promover una mayor confiabilidad en los resultados, sugerimos considerar la participación de expertos y usuarios.

1. Introduction

As consequence of Semantic Web, information management for e-learning systems is changing. An example of this is Learning Object (LO) concept which is a set of resources that could be used as independent and reusable units though different context and platforms. Each one of LO have metadata (data about data) for their description and administration. In this way it is possible to know what kind of LO we are trying but it doesn't means they has quality content.

There exists a plethora of quality criteria to value digital sources but there are only a few suggestions about how to evaluate LOs to structure quality courses. Our proposal consists on a system to evaluate LOs taking into account their characteristics with quality criteria into four categories.

In section 2 we propose our own definition about LO to identify the kind of LO to evaluate. According to this in section 3 we suggest a LO evaluation according to a knowledge model. To evaluate LOs section 4 suggest LOs evaluation taking into account an instrument that consider quality criteria from different points of view and a methodology of evaluation. To facilitate this evaluation we related our quality criteria with IMS LOM standard. Finally section 4 points out our conclusions and further work.

2. A learning object definition proposed

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An important contribution from computer science to knowledge management for e-learning system is the LO concept [3,6,7,12]. LOs have characteristics of being independent units, which are able to be reused in other educational situations.

On agreement with this, knowledge management for e-learning based on reusable LOs means the possibility of accessing specific content according to the learners' needs. To avoid interoperability problems there are some organizations that are working to develop standards and specifications to manage resources for e-learning systems.

To manage LOs, it is important to respond to what we understand for LOs. We define a LO as a "unit with a learning objective, together with digital and independent capabilities containing one or a few related ideas and accessible through metadata to be reused in different contexts and platforms" [5].

LOs must have a learning objective because it enables to direct the contents and material relating to them. Ideally a LO must contain different types of element which help to clarify the main idea. In this way learning could be reinforced, for example a unit of learning web site to teach some topic according to some objectives, content, images, etc.

For reusing LOs in many educational levels and contexts, it must include a principal or a few related ideas, in this way teachers are free to decide in which learning context they must be used. It is possible because LOs are not necessarily related to any time, methodology or instructional design.

Independent LOs characterized by one or few related ideas means the possibility to teach some topic by itself avoiding reusability problems. Accessible through metadata capabilities deliver the LOs characteristics providing different kind of information about them. Our proposal is based on IMS specifications for this reason we refer metadata considering IMS LOM (Learning Object Metadata) [9] which is a derivation of IEEE LOM [7]. Finally, LOs reusability means the possibility that a LO could be reused many times independent of software and platforms changes. This issue reflects their interoperability and durability characteristics.



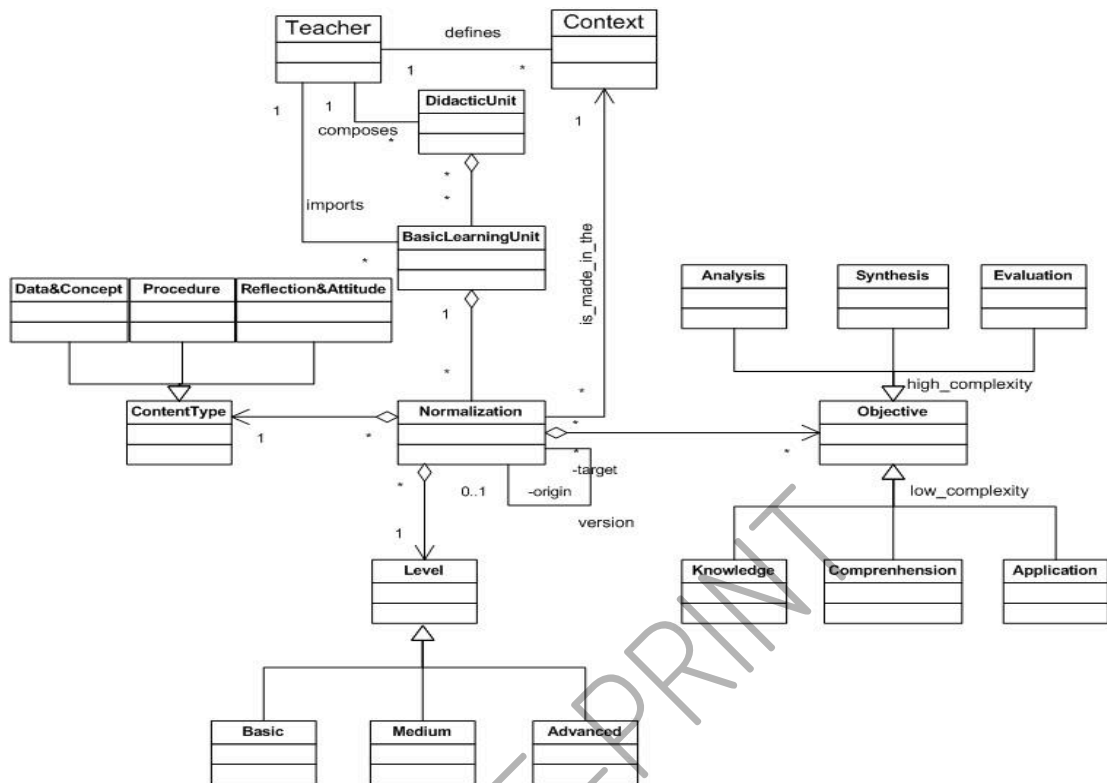


Figure 1. Knowledge Model

3. Normalization of learning objects according to our definition

According to reusable LOs capabilities, the first thing to consider is to import LOs. We think it is necessary to normalize them according to our definition because in this way it is possible to guarantee a suitable degree of granularity. Once LO has been imported, we suggest to normalize them according to a knowledge model like show figure 1. It represents the components of our proposed knowledge model and the relationships between them. Following this model, we suggest the next steps to normalize LOs.

- 1 **Classify LOs objectives according to their complexity level.** In this way it is easier knowing about their compatibility for suitable new educational situations. Then, we suggest Bloom's cognitive domain taxonomy [1] because it define what and how to learn according to complexity levels: low level (knowledge, comprehension and application) and high level (analysis, synthesis and evaluation)
- 2 **Define the difficulty level to each one of LOs,** for this issue we propose three kinds of complexity levels: basic, medium and advanced because this kind of classification would help teachers to select the LO content according to their teaching objectives.
- 3 **Classify the imported LOs into three kind of content:** data and concept, procedure or processes, and reflection or attitude. This classification aims to define the kind of content according to the learning objectives. This is an issue that may be important when teachers search LOs to structure their courses.

The classifications of LOs provided for the knowledge model allow teachers to find content according to the subject area, type of content, and level of difficulty.

Nevertheless, the classification of the LOs according to a knowledge model like this is not enough to guarantee their quality. Next we suggest our own LOs evaluation proposal.

4 LOs evaluation

According to [11], LOs may be evaluated taking into account their characteristics that made them different to other resources. LOs are characterized by the separation of their content and presentation, for this reason an important issue to consider evaluating them is their metadata information. Metadata, provide LOs information to their description and managing into different kind of categories, in this way it is possible to know if their characteristics are suitable for other educational situations. Educational category, contain different kind of pedagogical information that could be related with the context of new educational situations.

To evaluate LOs we think it is necessary by one side to establish evaluation criteria considering different points of view with regard to the same object and by the other side to relate its criteria with metadata specially educational category. For making easy this evaluation, we establish a relation between evaluation categories an IMS LOM [9], especially educational subcategory as shows Table 1. Relations established enable to relate each one of the elements of educational category metadata to quality criteria into four evaluation categories. It aim to measure metadata information quality from different kind of points of view. According to this, we suggest a LOs evaluation through an instrument which considers different evaluation criteria into evaluation categories.

- **Psychopedagogical category:** This category contains pedagogical criteria related to the psychology of learning. This kind of criteria aims to determine if the LO is suitable to promote learning.
- **Didactic-curricular category:** This kind of criteria aims to evaluate if an object is related to curricular objectives according to the context in which it will be applied.
- **Technical category:** Technical criteria are very important to making an integral LO evaluation because in this way it is possible to know the efficiency of the LO.
- **Functional category:** It is clear that a suitable functionality of an LO, has a lot in common with its quality. For example, if we have an object which doesn't work correctly it could obstruct the learning process. According to this it is possible to define several quality criteria depending of the LO type.

Table 1 Educational category Metadata with evaluation categories correspondence

Evaluation Categories	IMS LOM (Educational Category)
Psychopedagogical category Motivation capability Suitable for users	-Intended End User Role (Normal user of the resource, most dominant first) -Typical Age Range (age of the typical intended user) -Difficulty (how hard it is to work through the resource for the typical target audience)
Didactic-curricular category Objectives: feasible, good expressed Contents: description, accurately, reliable, suitable time to work	-Learning Resource Type (specific kind of resource, most dominant kind first) -Context (the typical kind of learners, e.g. school, etc.) -Typical Learning Time (approximate or typical time it takes to work with the resource) -Description (comments on how the resource is to be used)
Functional category	-Interactivity Type (the type of interactivity supported by the resource) -Interactivity Level (level of interactivity between an end user and the resource) -Semantic Density (subjective measure of the resource's usefulness as compared to its size or duration)
Technical category	Standard compliance: suitable format Metadata record: correct and complete information

For getting the final result, we propose the following rating scale: 0 = Criteria is not present; 1 = Very low; 2 = Low; 3 = Medium, 4 = High, 5 = Very high.

According to [10] we suggest the participation of at least two participants from each area to encourages not only different points of view over the subject under evaluation, but also a critical objectivity and a reliable LOs evaluation.

We propose two modes of applying the instrument suggested above in order to value the LO: individual and synchronic communication. According to this concept, individual evaluation provides us an initial appreciation of the quality of the LO based on the judgment of each participant. Evaluators must to evaluate LOs according to categories mentioned previously through an evaluation instrument because facilitate comparison among objects by providing a common review format.

In the didactic-curricular category we suggest some subcategories to evaluate LOs according to the knowledge model presented in figure 1 (objectives and contents). For LOs characteristics evaluation we suggest two criteria. First, LOs reusability, which means assessing whether the LO can be reused for other educational situations. Second, ensuring standard compliance, this means that it must be evaluated in the technical-aesthetic category.

The possibility of completing an evaluation through collaborative method enables to contrast the individual's initial evaluation with the others experts' evaluations. It aims to share different points of view to achieve an advanced and reliable evaluation [10]. However, the emergence of consensus is not always a fact, so we suggest publishing evaluators' disagreements, and as a result it will be possible to consider this information before the LO is reused.

LOs are individual units of learning or modules which are part of a didactic unit, it's mean they are part of the whole, however each one of LOs must be useful to be reused by itself in other didactic units [2,6].

To reuse LOs avoiding interoperability problems, an educational modeling language is needed. We also suggest IMS Learning Design [8] because it has a flexible structure that supports pedagogical diversity. The classification provided by the knowledge model could help for this work.

However, the LOs evaluation we suggested is not definitive. Once the LO evaluation has ended, it is necessary to make a LO re-evaluation, which considers a learners' experience about the efficacy of the LO to improve its quality [4]. Therefore a re-feeding process is needed which taking into account students' and teachers' contributions to the LOs quality.

5. Conclusions

To make suitable LOs evaluation a first thing we must to consider is LOs definition, we think our definition may be suitable for LOs management because it promotes a simple LOs contents that could help to reuse them in an easy way. Our normalization proposal helps to promote by one side a uniform LOs level of granularity and by other side the possibility to increment LOs reusability to another specific context. For example, if we associate a LO with a knowledge domain like Bloom taxonomy proposal, it is possible to attend different educational situations using different methodologies to show information attending different requirements.

LOs evaluation proposal is a way to evaluate them according to their characteristics. To ensure a suitable reusability LOs are characterized for the separation between their content and presentation. According to this, the relation presented between LOs metadata and quality criteria is a concrete way to evaluate LOs characteristics. Each one of evaluation categories aim to evaluate this characteristics into a concrete set, providing specific criteria to evaluate them. Standard compliance and metadata record evaluation into technical category aim to ensure their evaluation, according to this evaluators can to complete or correct metadata information.

We think there are other important issues to evaluate LOs that have to be taking into account. For example, into general metadata category is language element, it refers to the human language used by the typical intended user of the resource. Other important thing that could be evaluated is LOs presentation relating to technical-aesthetic aspects, for example, legibility, color-contrast, suitable size, interface

design, etc. Our future work is to implement this model in order to make possible adjustments and modifications, including the possibility to evaluate LOs according to a score weighting.

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