

## Learning objects evaluation

E. Morales Morgado <sup>\*1</sup>, F. García Peñalvo <sup>\*2</sup>, and A. Barrón Ruiz <sup>\*1</sup>

<sup>1</sup> Department of Theory and History of Education, University of Salamanca, Salamanca, Campus Canalejas. Pº de Canalejas, 169, 37008, Salamanca, Spain

<sup>2</sup> Department of Computer Science, University of Salamanca, Plaza de los Caídos s/n, 37008 Salamanca, Spain

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.

**Palabras clave:** Objetos de aprendizaje, *E-learning*, Calidad

### 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.

\* E. Morales Morgado: e-mail: solis15@usal.es, Phone: +34 923130385

\* F. García Peñalvo : e-mail: fgarcia@usal.es, Phone: +34 923294400 ext 1302

\* A. Barrón Ruiz: e-mail: ansa@usal.es, Phone: +34 9234500 ext 3378

## 2. A learning object definition proposed

An important contribution from computer science to knowledge management for e-learning system is the LO concept [3,7,8,13]. 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 is 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 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.

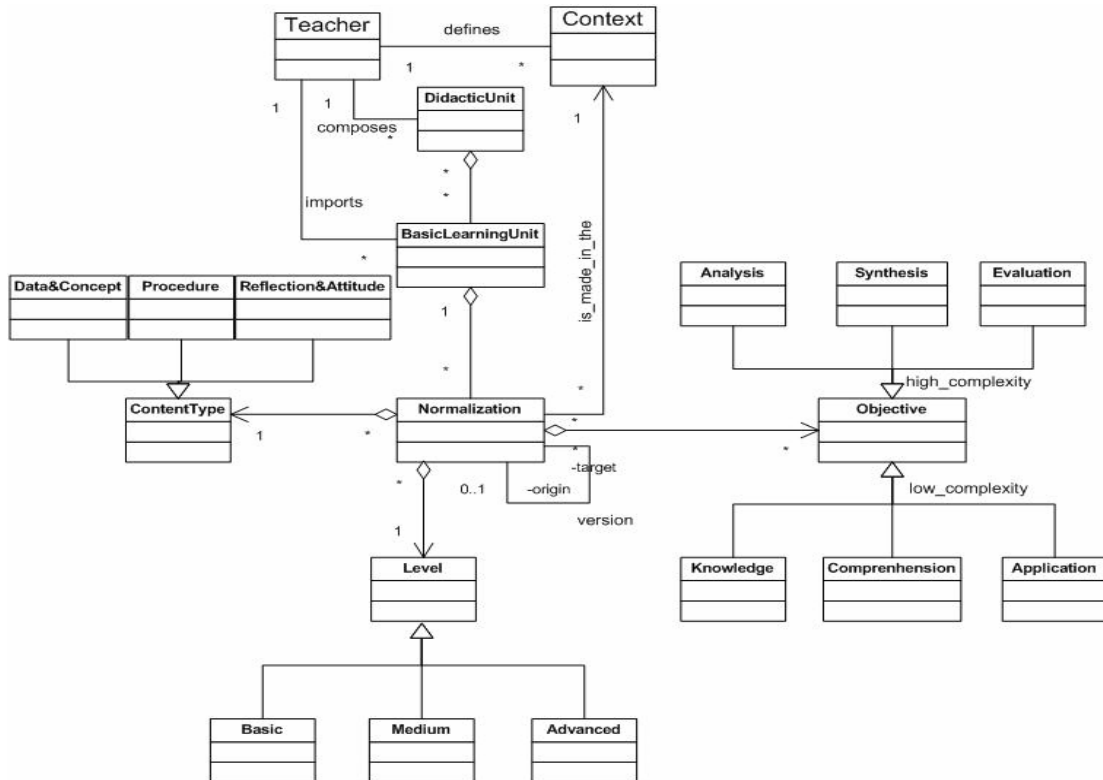


Figure 1. Knowledge Model

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) [10] which is a derivation of IEEE LOM [8]. Finally, LOs reusability means the possibility that a LO could be reused

1 many times independent of software and platforms changes. This issue reflects their interoperability and  
2 durability characteristics.

### 3 **3. Normalization of learning objects according to our definition**

4  
5  
6 According to reusable LOs capabilities, the first thing to consider is to import LOs. We think it is neces-  
7 sary to normalize them according to our definition because in this way it is possible to guarantee a suit-  
8 able degree of granularity. Once LO has been imported, we suggest to normalize them according to a  
9 knowledge model like show figure 1. It represents the components of our proposed knowledge model  
10 and the relationships between them. Following this model, we suggest the next steps to normalize LOs.

- 11 1 **Classify LOs objectives according to their complexity level.** In this way it is easier knowing about  
12 their compatibility for suitable new educational situations. Then, we suggest Bloom's cognitive do-  
13 main taxonomy [1] because it define what and how to learn according to complexity levels: low  
14 level (knowledge, comprehension and application) and high level (analysis, synthesis and evalua-  
15 tion)
- 16 2 **Define the difficulty level to each one of LOs,** for this issue we propose three kinds of complexity  
17 levels: basic, medium and advanced because this kind of classification would help teachers to select  
18 the LO content according to their teaching objectives.
- 19 3 **Classify the imported LOs into three kind of content:** data and concept, procedure or processes,  
20 and reflection or attitude. This classification aims to define the kind of content according to the  
21 learning objectives. This is an issue that may be important when teachers search LOs to structure  
22 their courses.

23 The classifications of LOs provided for the knowledge model allow teachers to find content accord-  
24 ing to the subject area, type of content, and level of difficulty. Nevertheless, the classification of the LOs  
25 according to a knowledge model like this is not enough to guarantee their quality. Next we suggest our  
26 own LOs evaluation proposal.

### 27 **4 LOs evaluation**

28  
29  
30 According to [12], LOs may be evaluated taking into account thier characteristics that made them differ-  
31 ent to other resorces. LOs are characterized by the separation of their content and presentation, for this  
32 reason an important issue to consider evaluating them is their metadata information. Metadata, provide  
33 LOs information to their description and managing into different kind of categories, in this way it is  
34 possible to know if their characteristics are suitable for other educational situations. Educational cate-  
35 gory, contain different kind of pedagogycal information that could be related with the context of new  
36 educational situations.

37 To evaluate LOs we think it is necessary by one side to establish evaluation criteria considering  
38 different points of view with regard to the same object and by the other side to relate it's criteria with  
39 metadata specially educational category. For making easy this evaluation, we establish a relation be-  
40 tween evaluation categories an IMS LOM [10], especially educational subcategory as shows Table 1.  
41 Relations established enable to relate each one of the elements of educational category metadata to qual-  
42 ity criteria into four evaluation categories. It aim to measure metadata information quality from diferent  
43 kind of points of view. According to this, we suggest a LOs evaluationg through an instrument which  
44 considers different evaluation criteria into evaluation categories.

- 45 • **Psychopedagogical category:** This category contains pedagogical criteria related to the  
46 psychology of learning. This kind of criteria aims to determine if the LO is suitable to promote  
47 learning.
  - 48 • **Didactic-curricular category:** This kind of criteria aims to evaluate if an object is related to  
49 curricular objectives according to the context in which it will be applied.
  - 50 • **Technical category:** Technical criteria are very important to making an integral LO evaluation  
51 because in this way it is possible to know the efficiency of the LO.
- 52

- **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	-Intended End User Role (Normal user of the resource, most dominant first)
Motivation capability	-Typical Age Range (age of the typical intended user)
Suitable for users	-Difficulty (how hard it is to work through the resource for the typical target audience)
Didactic-curricular category	-Learning Resource Type (specific kind of resource, most dominant kind first)
Objectives: feasible, good expressed	-Context (the typical kind of learners, e.g. school, etc.)
Contents: description, accurately, reliable, suitable time to work	-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 [11] 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 [11]. 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 [2,7]. To reuse LOs avoiding interoperability problems, an educational modeling language is needed. We also suggest IMS Learning Design [9] 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

1 LO re-evaluation, which considers a learners' experience about the efficacy of the LO to improve its  
2 quality [4,6]. Therefore a re-feeding process is needed which taking into account students' and teachers'  
3 contributions to the LOs quality.  
4

## 5. Conclusions

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

14 LOs evaluation proposal is a way to evaluate them according to their characteristics. To ensure a suit-  
15 able reusability LOs are characterized for the separation between their content and presentation. Accord-  
16 ing to this, the relation presented between LOs metadata and quality criteria is a concrete way to evaluate  
17 LOs characteristics. Each one of evaluation categories aim to evaluate this characteristics into a concrete  
18 set, providing specific criteria to evaluate them. Standard compliance and metadata record evaluation  
19 into technical category aim evaluators to complete or correct metadata information.

20 We think there are other important issues to evaluate LOs that have to be taking into account. For  
21 example, into general metadata category is language element, it refers to the human language used by the  
22 typical intended user of the resource. Other important thing that could be evaluated is LOs presentation  
23 relating to technical-aesthetic aspects, for example, legibility, color-contrast, suitable size, interface de-  
24 sign, etc. Our future work is to implement this model in order to make possible adjustments and modifi-  
25 cations, including the possibility to evaluate LOs according to a score weighting.  
26

## References

- 27 [1] B. Bloom, *Taxonomy of educational objectives: Handbook I, Cognitive Domain*, Davis McKay", (1956).
- 28 [2] Cisco Systems. Reusable learning object authored guidelines: How to build modules, lessons and topics,  
29 White papers, [www.cisco.com](http://www.cisco.com), (2004).
- 30 [3] D.A. Wiley, *Learning object design and sequencing theory*, Unpublished Doctoral Dissertation, Brigham  
31 Young University, Provo, UT, <http://reusability.org/read/chapters/wiley.doc>, (2000).
- 32 [4] E. Morales, F. García, *Quality Content Management for E-learning: General issues for a decision support*  
33 *system*, Proceedings of 7th international conference on enterprise information system (ICEIS), Miami, Mayo.  
34 <http://www.iceis.org>, (2005).
- 35 [5] E. Morales, F. García, A. Barrón, *Knowledge Management for E-learning based on Learning Objects. A*  
36 *qualitative focus*, Proceedings of 6th international conference on information technology based higher  
37 education and training (I THET), Santo Domingo, Junio. <http://ithet2005.uprm.edu/index.html>, (2005).
- 38 [6] E. Morales, F. García, A. Barrón, *Knowledge Management System to Re-feed Learning Objects Repository*,  
39 *Proceedings of the 3th international conference on multimedia and information & communication technologies*  
40 *in education (m-ICTE)*, Cáceres, Spain, 7-10 June, <http://www.formatex.org/micte2005/>, (2005).
- 41 [7] F. Moreno, M. Bailly-Baillière, *Diseño instructivo de la formación on-line. Aproximación metodológica a la*  
42 *elaboración de contenidos*, *Editorial Ariel Educación*, (2002).
- 43 [8] IEEE Standard for Learning Object Metadata. ANSI/IEEE, <http://ltsc.ieee.org/wg12/>, (2002).
- 44 [9] IMS LD. Learning Design Specification, <http://www.imsglobal.org/learningdesign/index.cfm>, (2003).
- 45 [10] IMS LOM. Learning Resource Metadata Specification, <http://www.imsglobal.org/>, (2003).
- 46 [11] J. Vargo, J. Nesbit, K. Belfer, A. Archambault, *Learning object evaluation: computer-mediated collaboration*  
47 *and inter-rater reliability*, *International Journal of Computers and Applications*, **25**, 3, (2003).
- 48 [12] M.A. Sicilia, *Reusabilidad y reutilización de objetos didácticos: mitos realidades y posibilidades*, I Simposio  
49 *Pluridisciplinar sobre Diseño, Evaluación y Descripción de Contenidos Educativos Reutilizables*. Guadalajara,  
50 Octubre 20-22, (2004).
- 51 [13] P. Polsani, *Use and abuse of reusable learning objects*, *Journal of Digital information*, **3**(4),  
52 <http://jodi.ecs.soton.ac.uk/Articles/v03/i04/Polsani>, (2003)