AN EVALUATION INSTRUMENT FOR LEARNING OBJECT QUALITY AND MANAGEMENT

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Abstract: Being able to evaluate the quality of LOs is crucial for reliable LO management. LO quality evaluation must take into account both their pedagogical and the technical characteristics. It also needs to consider them as units of learning and to determine their level of granularity (size). This paper describes a proposal for a specific LO quality evaluation instrument and presents the results of its assessment by a panel of experts.

1 INTRODUCTION

Information represents one of the world's most important sources of power today, and Internet growth is geared to promoting better services that will enable users to find and retrieve the information they really need.

The concept of learning objects (LOs) was devised in order to manage and reutilize existing e-learning resources without interoperability problems. However, the capacity of LOs to achieve that goal will be diminished if their quality is poor. With that in mind, we designed a quality evaluation instrument and had it assessed by a panel of pedagogical and technical experts.

This paper presents the background to our work, describing the quality evaluation instrument we developed and summarizing the experts' comments, before culminating in a round-up of our conclusions and future work plans.

2 THE LO QUALITY EVALUATION INSTRUMENT

Given that LO quality is crucial to LO management, surprisingly little work has been done in this area, resulting in just a handful of proposals for developing and enhancing LO design and evaluation tools and processes. Williams (2000), for example, proposes a process to desegregate and rebuild LOs using instructional design; and, as far as we are aware, the only evaluation instruments currently in use consider highly imprecise, general criteria such as motivation, interaction, feedback and so on: the Learning Object Review Instrument (LORI), for example, considers a basic set of nine such criteria, yet is used to evaluate LOs by major repositories such as the Co-operative Learning Object Exchange (CLOE) (http://cloe.on.ca/), the Digital Library Network for Engineering and Technology (DLNET) (http://www.dlnet.vt.edu/), and Multimedia Educational Resource for Learning and Online Teaching (MERLOT) (www.merlot.org).

The imprecision of those instruments is all the more serious in the light of the huge number of definitions of LOs. This makes it hard, in any endeavour to develop a means of enhancing LO quality and, hence, effective LO management for e-learning systems, to have a clear idea of what actually constitutes an LO.

As LOs come in many different sizes (levels of granularity), we decided to produce a precise definition of LO granularity based on IEEE LOM (2002) and featuring the following additional details (Morales, García and Barrón, 2007c):

- Level 1: the lowest level of granularity, e.g. an image used in a lesson (photo, video, etc).
- Level 2: a lesson – possibly a group of level 1 LOs – focusing on a specific learning objective with a specific kind of content (data and concepts, process and procedure, principles, etc.), with optional exercises (for practice and/or examination).

PEDAGOGICAL CRITERIA FOR LEARNING OBJECTS EVALUATION	D/N= Don't know, 1=Very Disagree, 2=Disagree, 3=Agree 4=Very Agree
PSYCHOPEDAGOGICAL	
Motivation and Attention	3,7
Presentation: Capture learners attention mantaning their motivation	3,6
Add important information: Information need to be relevant according to the LO subject	3,7
Learners participation: LO explains very clear how learners can to participate in the lesson	3,8
Professional competence	3,9
Learning objectives help users to achieve their professional competences	3,9
Difficulty level	3,6
Contents difficulty level: It needs to be suitable for user cognitive domain	3,6
Language: It needs to be suitable for previous users knowledge	3,5
Interactivity	3,5
Interactivity Level: It promotes opportunities to interact with LO in different ways	3,6
Interactivity type: LO interaction aims to achieve learning objectives	3,4
Creativity	3,8
It promotes self-learning	3,8
It promotes cognitive domain development	3,7
GENERAL COMMENTS (Describe some examples where this LO can be reused)	3,7

Figure 1: Psychopedagogical item into Pedagogical criteria for LO evaluation.

- Level 3: a learning module made up of a set of level 2 LOs (lessons) plus at least two or three kinds of content (data and concepts, process and procedure, principles, etc.), with optional exercises (for practice and/or examination).
- Level 4: a learning course made up of a set of level 3 LOs (modules) plus at least two or three kinds of content (data and concepts, process and procedure, principles, etc.), and optional exercises (for practice and/or examination).

LOs must be clearly defined in order to be able to establish specific quality evaluation criteria. We must know exactly what we are evaluating. To define a quality evaluation instrument, we decided to consider LOs as basic units of learning – as in the case of the prototype LOs in our Salamanca University pilot project (Morales, García and Barrón, 2008) – because we believed them to be consistent with the core idea of the LO concept. We used this as a basis upon which to determine the kind of criteria that would serve to evaluate the pedagogical and technical aspects of LO quality, i.e. whether or not, and to what degree, the learning resources in question displayed characteristics suggesting that they could effectively achieve the specified educational goals.

To achieve those goals, LOs must embrace a specific range of curricular and psycho-pedagogical issues. Curricular issues concern the subject matter, the goals and so on, while psycho-pedagogical issues concern the user's characteristics (age, learning ability, motivation, etc.).

We established a set of quality criteria for evaluating pedagogical aspects of LOs (figure 1), and then divided those criteria into categories and sub-categories containing more detailed criteria. Each of these was assessed by a panel of ten educational and technical experts who rated each item according to the following scale: D/N=don't know; 1=very disagree; 2=disagree; 3=agree; 4=very agree.

Once the experts had rated the criteria, they each had the chance to comment on them and suggest ways to improve them in a face-to-face interview. The overall rating (3.7) reflects their unanimous agreement that the proposed criteria were sound. The highest scoring criterion was 'professional skills' (3.9), meaning that the LOs were considered very well suited to helping students achieve their objectives and enhance their professional skills.

The next highest scoring items were 'creativity' (3.8), which the experts said would be useful if the LO promoted meta-cognitive skills and self-learning; 'motivation' (3.7), which was considered crucial for any kind of learning material; and 'interactivity level' (3.5), which was regarded as critical for promoting active student participation, but whose evaluation depended on the learning objectives because the LOs could include lectures or other 'passive' activities.

PEDAGOGICAL CRITERIA FOR LEARNING OBJECTS EVALUATION	D/N= Don't know, 1=Very Disagree, 2=Disagree, 3=Agree 4=Very Agree
DIDACTIC-CURRICULAR	
Context	3,8
Formative level	3,5
Subject description	4
Objectives	3,7
Formulation	3,6
Factibility	3,7
Describe the materia that need to be learned	3,8
Coherent with general objectives	3,7
Learning Time	3,5
Time destined for learning activities may be congruent with the time disponible	3,5
Contents	3,7
Present enough information and suitable for the educational level	3,7
Contents are suitable for the proposed objective	3,7
LO present information considering different kind of formats (text, audio, etc.)	3,6
LO provide contents interacion by some links	3,6
LO present complementary information (glsosary, aids, etc.)	3,8
The information is reliable	3,9
The information presentation aims to obtain a better contents comprehension	3,7
Language is suitable respect on learning objectives	3,5
Activities	3,8
They help to reinforce the concepts	3,9
Promotes an active participation	3,7
Presents different kind of learning strategies	3,9
Presents evaluation and practice activities	4
They proposes work modality (if if is the needed)	3,7
Feedback	3,9
Knowledge is reinforced by exercises and activities, self-evaluation, etc.	3,9
GENERAL COMMENTS (Describe some examples where this LO can be reused)	**3,7**

Figure 2: Didactic-curricular section of pedagogical criteria for LO evaluation.

The next section of the LO quality evaluation instrument focuses on didactic-curricular items, a sub-category of pedagogical criteria (figure 2).

Once again the overall rating was very high (3.7). The highest scoring item was 'feedback' (3.9), which the experts said was especially important for LOs because it provided pointers for reinforcing them and their capacity to serve as basic units of learning and knowledge containers, thereby helping prepare students for other, more advanced and complex, LOs.

A similarly high score was given to 'context' and 'activities' (3.8), with the experts saying that context was crucial to an LO's value and reusability. The LO quality evaluation instrument must therefore assess whether an LO is suitable for the formative level and provides a clear enough description of its subject.

Next came 'objectives' and 'content' (3.7). The experts approved of the fact that these criteria sought to assess formulation, feasibility and other such fundamental issues. It is interesting to consider the evaluation of specific objectives and how they relate to general objectives because the aim is to rate the consistency and sequence of a group of LOs (a module, didactic unit, course, etc.)

Finally, the lowest scoring didactic-curricular item was 'learning time' (3.5). The experts described this as crucial to learning activities but said that in some cases learning time needed to be modified during the activities according to the objectives, the students' characteristics and so on. They approved of this criterion because it was designed to assess whether enough time was devoted to learning to complete the allotted tasks.

As mentioned earlier, an LO quality evaluation instrument must also cover technical criteria. In order to identify these we analysed a number of proposals for rating such items as multimedia sources (Marques, 2000), educational web pages (Marques, 2003; Torres, 2003) and usability (Nielsen, 2000). On this basis, and with the LO as we define it serving as a digital basic unit of learning, we decided to sort technical issues into two categories: interface design (figure 3) and navigation design (figure 4) (Morales. García and Barrón, 2007a).

The highest scoring items into interface design were 'images' and 'animations' (3.7), and the

USABILITY CRITERIA FOR LEARNING OBJECTS EVALUATION	D/N= Don't know, 1=Very Disagree, 2=Disagree, 3=Agree 4=Very Agree
INTERFAZ DESIGN	
Text	**3,5**
Text need to be organized in short paragraphs. It is important to don't romper the patagraphs continuity and the ideas which they contain.	3,4
It is recomendable that LOs consider at least the half part of a text which could be used for printed publication.	3,4
It is advisable to use hipertext to divide large ionformation in multiples pages.	3,6
Marc contents using titles, epighaphs, etc.	3,5
Different pages need to have different titles.	3,5
The use of capital letter need to be used only for titles, headlines or for points out specific text.	3,4
It is advisable to avoid underline text when there are not text links.	3,3
Text need to have legible kind of letter and suitable size.	3,5
The colours and kind of letters provide information by itself.	3,6
Text don't have to present any ortographic mistake.	3,9
Imagen	**3,7**
Images complement and support the information.	3,6
Images don't are superflues, they need to be present only if it is necessary.	3,7
Animations	**3,7**
The animations used need to be justified.	3,7
They need to atract the users attention to point out important information.	3,6
Animations don't have to take a long upload time.	3,7
It is advisable to avoid animations which are repeiting all the time (loop).	3,7
Multimedia	**3,5**
Multimedia use need to aport and be justified.	3,6
The format and file size need to mention if its download time take more than 10 seconds.	3,4
Sound	**3,5**
Sound need to be used only if it is necessary. Users need to have the opportunity to listen the sound in an optional way.	3,5
Users need to be informed if the sound file characterisctics before to dowlown it (size, kind of conection, etc.	3,4
Vídeo	**3,6**
Need to serve as a complement of vídeo and images.	3,6
They use need to be justified.	3,6
The images and audio need to be as clear as possible.	3,5
GENERAL COMMENTS (Describe some examples where this LO can be reused)	**3,6**

Figure 3: Interfaz design item into Usability criteria for LOs evaluation.

USABILITY CRITERIA FOR LEARNING OBJECTS EVALUATION	D/N= Don't know, 1=Very Disagree, 2=Disagree, 3=Agree 4=Very Agree
NAVIGATION DESIGN	
HOME PAGE	**3,7**
Users need to be clear what places are visiting and the what are the LO objectives	3,9
Page need to present a directory considering the main contents area and links to complement the information	3,6
The welcome pages do'nt have to slow down the users interaction	3,8
NAVIGABILITY	**3,7**
The structure need to be flexible in order to aim users to control their navigation.	3,8
Titles need to be present and be clear into ecah one of LOs pages	3,7
La intefaz de navegación muestra todas las alternativas posibles al mismo tiempo, para que los usarios puedan escoger su opción	3,7
Users need to be clear where are they in each page	3,7
Users need to be clear where are they into site structure	3,8
The page design is directed in grant part to the subject contents.	3,7
Pages need to be simple no recharged	4
The page design need to be strong into each one of the pages (size, colours, iconos, kind of letter, etc.).	3,7
GENERAL COMMENTS (Describe some examples where this LO can be reused)	**3,7**

Figure 4: Navigation design item into Usability criteria for LOs evaluation.

experts approved of the proposed criteria because such resources could help boost the learner's motivation and provide useful information to complement the text. Similar comments were made in regard to the next highest scoring item: 'vídeo' (3.6).

Then came 'text', 'sound' and 'multimedia' (3.5), whose slightly lower score reflected the fact that these are highly specialized domains with which some of the experts were unfamiliar.

The experts deemed it important, therefore, that those using the evaluation instrument either be acquainted with the subjects covered by the various criteria, or to omit those criteria from their evaluation.

The experts approved or fully approved of all of the items in the final section of the instrument, covering usability criteria with a specific focus on navigational aspects (figure 4).

The highest scoring item was 'are web pages simple and devoid of heavy graphics' (4.0). Next came 'does the user know the places they are visiting and the objectives of the LO' (3.9). This was followed by three separate items: 'do home pages slow down the user's interaction with those pages' (potentially demotivating); 'is the page structure flexible enough to allow the user to play an active role during navigation'; and 'is the user aware of where they are within the site architecture' (3.8).

The remaining five navigation-relation items all achieved a score of 3.7.

The post-evaluation face-to-face interviews with the experts enabled us to gather qualitative information on the instrument itself together with a number of suggestions for their improvement. All of the experts agreed with the criteria proposed and the items considered.

They also suggested editorial changes in the wording of the items. Some said that it was advisable to avoid the use of expressions such as "must have" because they were too imposing and could complicate matters for the evaluators.

On the other hand, the items should be worded briefly and should avoid using examples likely to influence the evaluation. All figures in this paper have been corrected according to the experts' qualitative evaluation.

In the final comments, some of the experts suggested other kinds of scales aimed at rating specific aspects of LO quality. Based on their suggestions we have decided to introduce the following version into our instrument as shows the Table 1.

Table 1: LOs evaluation rating scale.

Scale Range	Value
1,0 – 1,5	**Very Low**: LO quality is too bad, it need to be eliminated
1,6 – 2,5	**Low**: LO quality is bad, it requires a big improvement
2,6 – 3,5	**Acceptable**: LO quality is not bad, however it needs to be improved
3,6 – 4,5	**High**: LO quality is good but can be improved
4,6 – 5,0	**Very High**: LO quality is quite good, it does not need to be improved

For a balanced LO quality evaluation we suggest calculating an average final score for each of the four sections of the instrument so as to be able to extract a specific value to add to our LO metadata typology based on the LOM 9. Classification metadata category (Morales, García and Barrón, 2007b). The aim here is to introduce numeric values that will help the user find and retrieve LOs according to quality-related criteria, and enable us to develop more sophisticated LO management capabilities, e.g. automated means using intelligent agents that will pave the way for new quality-based LO management tasks (Gil, García and Morales, 2007), (Morales, Gil and García, 2007).

3 CONCLUSIONS

Our model LO quality evaluation instrument contains a wide variety of criteria aimed at enhancing the core pedagogical quality of LOs: meaningful logical and psychological criteria. The first set of criteria concerns curricular issues, i.e. whether the LO is consistent with the study programme objectives, content, activities and so on. The second centres on the learners' characteristics: learning ability, motivation, interactivity, and so on.

In order to produce a holistic evaluation of an LO's quality as a pedagogical digital resource (in line with our definition of what constitutes an LO), the instrument also focuses on assessing technical criteria. As these types of resources can consist of different kinds of media, our model therefore takes into consideration the most commonly used multimedia resources: images, video, etc.

Finally, since LOs are composed of different kinds of media, it is important to ensure that each is rendered accessible: e.g. an Internet site or web page designed to enable all kinds of users to access them,

taking into account personal characteristics, navigation context, etc.

If we want to promote holistic LO quality, we must seek to evaluate their accessibility, bearing in mind the basic technical rules for accessible web development: e.g. the Web Content Accessibility Guidelines (WCAG), which promote the Web Accessibility Initiative (WAI) (http://www.w3.org/WAI/). In so doing, we can help enhance LO quality not only for existing resources, but also for those under development.

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