Learning Objects Searching based on Skills Development

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ABSTRACT
Nowadays there are a large amount of virtual libraries and repositories of resources, where people can access and great variety of information in multiple fields of knowledge. One of these types of data is Learning Objects (LOs), which contain metadata to locate and recover them, according to the specific educational needs of users.

Educational objectives are clearly oriented to skills development. Therefore, it is important to consider educational materials that promote their use. Due to the LOs characteristics as independent units that can be reused, we propose a guide to LOs design with the aim of developing these resources according to levels of knowledge required for competency development.

In order to promote the learning objects management based on skill levels, we suggest that their metadata be cataloged by level of knowledge and competencies classification.

General Terms
Knowledge management, Learning skills

Keywords
Learning objects, Competence based learning, Metadata

1. INTRODUCTION
Knowledge management is now a key aspect to search, process and retrieve relevant information according to user needs. The Web is a major source of information for training, therefore, requires proper management of educational resources to promote quality learning, allowing students to cope in an active and efficient way in this age of information.

The possibility offered by the educational standards to manage Learning Objects (LO), facilitating interoperability and reuse across multiple platforms, and the existence of educational modeling languages that can be structured in order to teaching meaningful topics, open a great possibility to improve online education systems [6].

To achieve effective LOs management, it is important to properly classify them through metadata. The metadata standard reference for the Spanish speakers is the LOM-ES, an adaptation of LOM into Spanish language, which also has more "educational purposes", which includes educational and pedagogical characteristics, such as: recipients, difficulty, level of interactivity, etc.

The listing of resources is determined in some cases by the place where they are stored. Section number 2, introduces the concept of learning objects repository and the case of "Agrega project", that promotes the learning objects classification according to the Spanish curriculum.

Section 3 analyses the competence definition and its characteristics making stand out their importance for learning objects design. On this basis, section 3.1 suggests a proposal for independent learning objects design in order to promote conceptual, procedural and reflection skills. Section 3.2 presents a proposal for learning objects classification taking into account the "9.Classification" IEEE LOM metatada category. In this case, we suggest specific data directed to the skills mentioned above. Finally, section number 4 presents our conclusions and further work.

2. LEARNING OBJECTS REPOSITORY
Learning Objects are grouped and stored in Learning Object Repositories (ROA). Formally, a ROA is a collection of LOs, which have detailed information about themselves (metadata) and are accessible via Internet [5]. It is possible to identify two types of repositories [3]. On the one hand, repositories containing LOs and their metadata, where objects and their descriptors are within the same system and even within the same server.

By other hand, there are those repositories that contain only the metadata; in this case the repository contains only descriptors and access to OA through a reference to its physical location, which is in another system or repository.

The importance of managing resources to meet specific user needs has been well regarded in the education field. A concrete example is the "Agrega" project (http://www.proyectoagrega.es), which houses a content repository, which stores content packaged as a SCORM schema extension 2004 [5], which allows references to external resources and documentation based on the LOM application profile-ES (http://www.lom-es.es/).

The Agrega project has as its main objective to define a standard reference documentation, packaging and publication of digital educational content. About the resources documentation Agrega repository, has a basic catalog, which allows teachers to add easily in a concisely way the following information: title, language, description, resource type and language of the final users.

Another important aspect to note about "Agrega" project, is that it adds the Spanish curriculum as a means of classify and search the learning objects according to its insertion in the Spanish educational area. It is achieved through a subset of LOM-ES metadata standard. It is especially useful for users who do not have knowledge of the standards like SCORM and LOM-ES.

Other LOs repositories to be found are:

- o IIEP-UNESCO • Wiki of OER repositories: UNESCO / IIEP hosts a Wiki which provides a list of several portals, gateways and repositories. Offers a list of links to OER initiatives, resources and tools. Was compiled following the first IIEP discussion forum on Open Educational Resources (October 24 - December 2, 2005). Provides access to a selection of about 30 repositories of open learning objects, most university level.

- o MERLOT (Multimedia Educational Resource for Learning and Online Teaching), centralized repository that contains only metadata. It is independent and acts as a portal for learning objects. Objects evaluated by peer review. Free and open. http://www.merlot.org/.

- o CARE (Campus Alberta Repository of Educational Objects), centralized repository of learning objects. It gives independent access to local and remote objects through the metadata contained in your collection. Free and open. http://www.careo.org.

- o CLOE (Co-operative Learning Object Exchange), cooperative model for the development, use and reuse of learning objects. http://cloe.on.ca/.

- o SMET (Science, Mathematics, Engineering and Technology Education), distributed repository, which includes several libraries of educational resources. Access is free for consultation. http://www.smete.org/smete.

- o GEM (Gateway to Educational Materials) is a project of the Department of Education in the U.S. Oriented interoperability between multiple databases through the use of modules that extract metadata objects in GEM format. http://www.thegateway.org/.

- o POOL (Portals for Online Objects in Learning), a consortium of educational organizations to create a large distributed repository. http://www.edusplash.net.

- o Celebrate (Context eLearning with Broadband Technologies), raises a central repository with a partial administration of metadata by the user. http://celebrate.eun.org/eun.org2/eun/en/index_celebrate.cfm.

- o ELENA / Edutella, part of a larger project in which Elena is a layer of the infrastructure that connects applications with different types of repositories, search patterns and different metadata schemas. http://www.elena-project.org.

- o EduSourceCanada, this project is a proposal to create a network of ROA in Canada, joining the main repositories created in this country. http://www.edusource.ca.

- o Digital School Library. Free Repository supported by Sanchez Ruiperez Foundation. OA can be obtained from primary, secondary or high school. http://www.bibliotecaescolardigital.es/.

3. LEARNING OBJECT DESIGN FOR SKILLS DEVELOPMENT

As is well known, one of the main objectives of the Bologna treaty is to increase the competitiveness of the European university. To achieve this objective, it is proposed to involve students in an educational experience based on developing skills that help them to achieve excellence in know-what (knowledge), know-how (skills) and know about to (attitudes), in order to achieve high performance in their professional performance.

A competency is defined as "an underlying characteristic of a person who is causally related to performance, referred to a higher standard, at a job or situation" [2], [9], [10]. Among the components of competencies are:

- o Knowledge, systematic knowledge acquisition, classification, theory, etc. In scientific fields or professional area.

- o Abilities and skills: Training in methodological procedures applied in scientific fields or professional area (organize, apply, manipulate, design, etc.).

- o Attitudes and values, attitudes and values necessary for professional practice: responsibility, autonomy and initiative in complex situations, coordination, etc.

Due to the previous amount above, the design of educational materials geared to skills development, today takes a special importance. The design of LOs is an issue that is not clearly defined and because of its characteristic of independent units. It would be interesting to have a proposal to help design, which allows reuse as self-contained units, associated with different types of expertise required for skills development.

3.1 Design of independent units to skills development

Due to the diversity of LO definitions, there is not a design model adopted by excellence, however, so that they achieve greater reusability is desirable that the design and creation meets minimum units of learning. If well endowed certain levels of content, for example, of a "conceptual" or "procedimental" we can facilitate the search and recovery of resources best suited to the specific learning needs.

In order to guide the design of learning objects to skills development, then presents a proposed design for a specific lesson, focused on content development, basic skills development, which together can form larger units of learning.
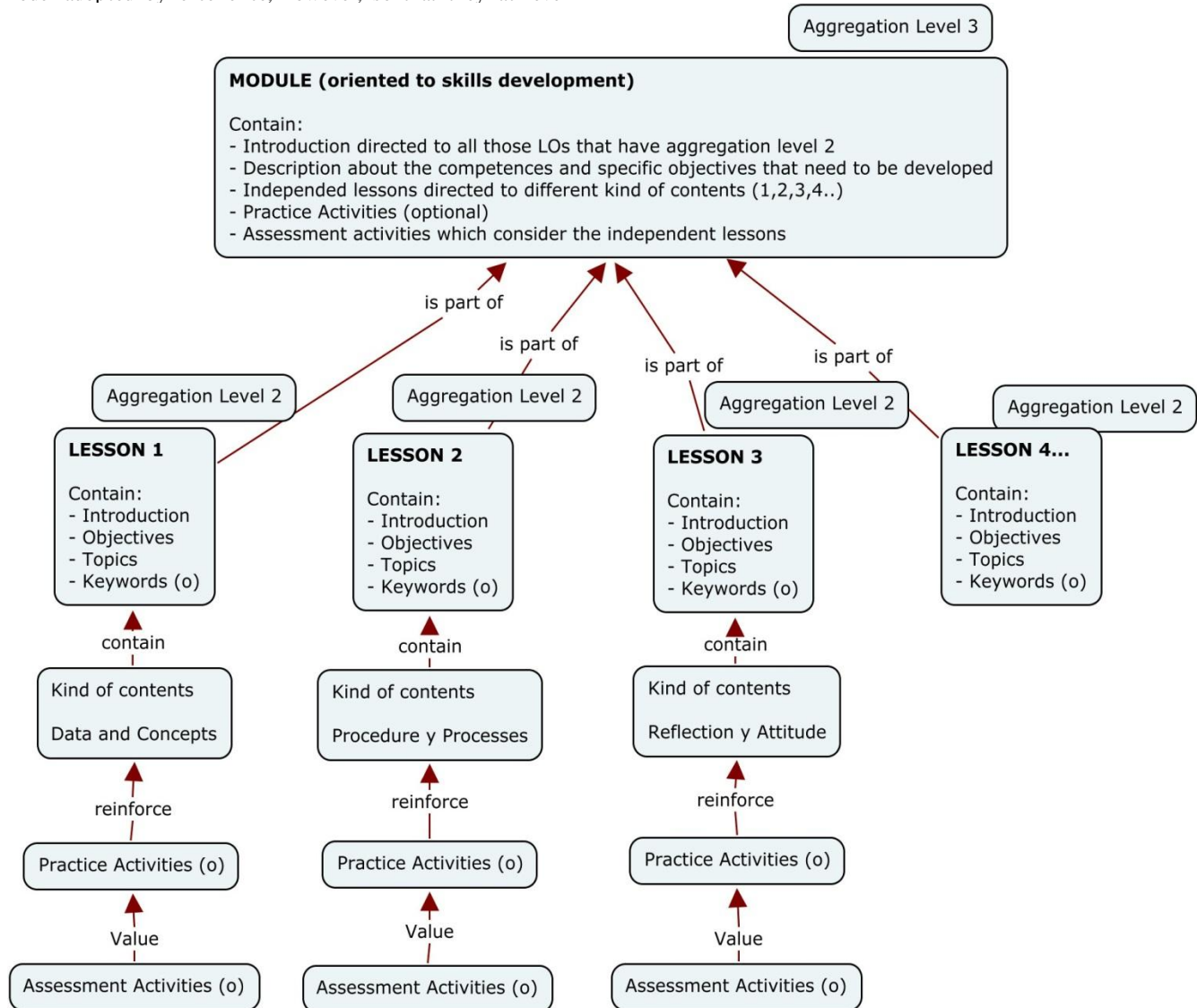

Fig 1: A proposal for learning objects module design directed to skills development.

These groups of LOs, that will shape new educational units at various levels, should be classified to know specifically what type of OA is being managed. Considering the level of granularity or size proposed by IEEE LOM (2002), this proposal suggests the following classification [7].

- o OA level 1 refers to the atomic or granular level of aggregation, e.g. images, text or video segments [4].

- o OA level 2: A lesson with a specific learning objective, a type of content (data and concepts, or procedures and processes or thinking and attitude) and finally and evaluation activities and practice (optional).

- o OA level 3: A learning module consists of a set of lessons (OAs Level 2)

- o OA level 4: A course consists of a set of modules (OAs Level 3). To design a lesson in OA, we consider the size that includes the minimum requirements so it can be reused as educational unit, i.e. level 2. For the design to be pedagogical, we suggest the following components, shown graphically by Figure 1.

  - o Introduction to the topic, where you must define the objectives as the cognitive level and the level of difficulty. The agenda will be associated with specific content type. Explicit indication of keywords related to LO, may be useful to find other related resources.

  - o Content related to a specific type of knowledge needed to achieve a certain competence, namely:

    - ▪ 'knowing what' (data and concept) or

    - ▪ "know how" procedures and processes or

    - ▪ "know about" thinking and attitude

  - o Assessment activities, which may be optional depending on the case, they are clearly specified types of activities, type of work and strategies.

According to the Figure 1, it is possible to compose larger units of learning, for example, a teaching unit and a course. To design a teaching unit or module, is taken into account the level of granularity number 3, as defined in the previous section, led in this case to develop one or more skills.

To promote this goal, it should be composed of several lessons, containing the three types of content mentioned above, which are needed to achieve a certain competence.

When a teaching unit or course is built, based on the reuse of smaller units, it is important to consider a way to connect all together as a whole, aimed at the attainment of higher goals, for example:

- o Introduction to the teaching unit, indicating the powers are to be developed, the lessons will, objectives necessary to achieve a certain cognitive level, the level of difficulty, etc.

- o Learning and assessment activities (as applicable), to help to reinforce knowledge of each level of

knowledge and connect all three together to promote the achievement of competencies described in the teaching unit.

On this basis, the course design could be composed of independent learning units, designed to develop different skills and these in turn, composed of self-contained lessons that can be reused as educational needs.

3.2 A Proposal for learning objects classification according to a specific level of knowledge

Within LOM-ES metadata categories, there is not a specific item that refers to the learning objects content type. However, there are other elements that allow you to enter free text, such as resource description, but this option is used more to discuss the conditions of use of educational resources.

LOM-ES has a category called "9.Clasification" that allows defining specific classifications for the resources as specified purposes. Given the importance of the various levels of knowledge, it is interesting to include the learning object content type as a possible LOs classification.

On this basis, this work proposes to classify the LOs according to specific "Content Type", based on levels of knowledge referred to skills development.

The proposal is presented in Tables 1, 2 and 3, which is based on the "9.Clasificación" LOM-ES metadata category. Each one of them proposes a specific data definition that can be added to specify the different skill levels mentioned above.

Table 1 shows the "9. Classification" metadata category, adapted to the LO classification by type of content "data and concepts". The element "9.2.1 Source" defines the name of the classification system, which in this case is defined as "Content Type".

Table 1. Proposal to classify LOs according to the type of content "Data and Concept" into "9.Classification" category.

Nº	Name	Example
9.1	Purpose	Kind of content
9.2	Taxon path	
9.2.1	Source	Data and Concept
9.2.2	Taxon	TP_DC = data and concept
9.2.2.1	Id: Taxon identifier in taxonomic system	TP_DC
9.2.2.2	Entry: Taxon name or label	Data and Concept

Nº		
	(other than identifier)	
9.3	Description: A textual description of learning object relative to its stated purpose.	Data: A group of objects, symbols, ideas or events that are defined by a single word or term. Concept: Abstract principles, general methods, theorems, etc.
9.4	Keyword: Main words relative to its stated purpose.	Names, dates, facts, facts, features, abstract principles, general methods, theorems

A taxon is a specific term within a taxonomy. The taxon can be alphanumeric characters in order to be used as a reference standard to avoid mistakes when seeking the information under this criterion. On this basis, it has been defined by way of example, the item "9.2.2 Taxon" the following value: "TC_DC is Data and Concepts", where TC corresponds to "type of content" and DC corresponds to "Data and Concepts".

The element "9.2.2.1 Identificator" corresponds to the taxon identifier, as a number or letter combination provided by the source of the taxonomy, in this case is defined as Content Type Data and Concepts = TC_DC. The item "9.3 Description", explains the classification defined, so you can better understand the type of information referenced to this kind of classification.

It is important to note that, these definitions constitute only a reference to describe the type of content. Teachers can give their own description about them.

Finally, the item "9.4 Keywords", defines some examples of conceptual terms, which can be used for your search according to this classification.

Along the same lines, Tables 2 and 3 show an example of the LOs classification for the types of content "procedures and processes " and "reflection and attitude" respectively.

Table 2. Proposal to classify LOs according to the type of content "Procedures and Processes" into "9.Classification" category.

Nº	Name	Example
9.1	Purpose	Kind of content
9.2	Taxon path	
9.2.1	Source	
9.2.2	Taxon	TC_PP=procedures and process

Nº		
9.2.2.1	Id: Taxon identifier in taxonomic system	TC_PP
9.2.2.2	Entry: Taxon name or label (other than identifier)	procedures and process
9.3	Description: A textual description of learning object relative to its stated purpose.	Procedures: sequenced steps describing a task, etc. Process: sequenced phases describing how a system works
9.4	Keyword: Main words relative to its stated purpose.	processes, procedures, steps

*where TC_PP corresponds to: Content Type Procedures and Processes.

The contents described in the item "9.3. Description "summarize the difference between procedures and processes, but both to a greater or lesser extent, are related to the "know-how" level of knowledge.

Keywords showed in the tables are just one example of a way to identify the search for LOs, based on this kind of level of knowledge.

Table 3. Proposal to classify LOs according to the type of content "Reflection and Attitude" into "9.Classification" category.

Nº	Name	Example
9.1	Purpose	Kind of content
9.2	Taxon path	
9.2.1	Source	Reflection and Attitude
9.2.2	Taxon	TP_RA = Reflection and Attitude
9.2.2.1	Id: Taxon identifier in taxonomic system	TP_RA
9.2.2.2	Entry: Taxon name or label (other than identifier)	Reflection and Attitude
9.3	Description: A textual description of learning object relative to its stated purpose.	Data: A group of objects, symbols, ideas or events that are defined by a single word or term. Concept: Abstract principles, general

		methods, theorems, etc.
9.4	keyword: Main words relative to its stated purpose.	Names, dates, facts, facts, features, abstract principles, general methods, theorems

*where TC_RA corresponds to: Type of Content_ Reflection and Attitude.

LO recovery from a repository, according to the type of content, is also valuable information, so that teachers can decide whether the appropriate remedy is not recovered for reuse with other LOs and build new teaching units and courses.

In addition to the previously described classification, LOs can be categorized by competences, in this case, it could be possible to search and recover complete didactic units, incorporating the three levels of knowledge described above. According to this we present a specific proposal for their cataloging and searching.

3.3 A Proposal for learning objects searching based on specific competences

The competency-based learning is now a necessity for any organization. Thus there are currently several initiatives that promote the standardization of skills, as the case of the tuning project (*http://tuning.unideusto.org/tuningal/*), coordinated by various American and European Universities, which has as one of its main objectives to develop professional profiles in terms of generic and relevant area of studies, including skills, knowledge and content in the thematic areas included in the project.

Another case in point is the National Catalogue of Professional Qualifications (CNCP) (*http://www.educacion.es/educa/incual/ice_catalogoWeb.html*), which comprises the most important qualifications of the Spanish production system organized into families and professional levels.

On the basis of certain standardized skills, such as promoting the project tuning and catalog (CNCP), it is possible to classify LOs through metadata category "9.Clasificación" as described in the example above. Due to the hierarchical organization that have standardized skills, sorting through the metadata, consider the general skills and a secondary and dependent, the competences of the specific areas of knowledge, which are related to the three kind of contents we have suggested above.

Cataloging skills can be further complemented by a set of keywords, through the "General" LOM category. In order to link the searching of some keywords and skills it is necessary to develop a panel that indicates some rubrics to associate word and competencies together with their description.

The structure of keywords (tags) related to competencies, would be associated with the category "general" and "password". This field is proposed to be used despite the fact that it is not necessary in LOM-ES. In addition, it is expected that it coexists seamlessly with the keywords that describe the focus of the learning object, allowing search by tags related to the topic of the object and the skills sought.

4. CONCLUSION

Manage information through the technologies possibilities are innumerable, but it is not very common to used properly its potential to solve problems that affect organizations for a long time in order to provide their employees with adequate information for training.

Learning Objects are an interesting alternative for managing educational materials, where teachers can create and share its resources and to search and retrieve those that have been created by others. The proposal described in this paper to classify LOs according to certain levels of knowledge and skills, is an interesting alternative, even as an enhancement to the "Agrega" project about their LOs classification system. This is how you could add a new category to the tree curricular project, two new sources of classification and search. The first, based on a competence system established by adaptation to the general competencies defined by the Tuning project and the latter as a secondary category that depends on the previous systems based on the competencies of the specific areas of knowledge.

It is also possible using an advanced cataloguer based on LOM-ES metadata standard, where keywords can be defined through "controlled folksonomies", i.e. collective labels added by users, as is done in various social classification systems, such as: web page bookmarks (*del.icio.us*), photos (*Flickr*), etc.

The structure of keywords (tags) related to competencies, would be associated with the category "general" and "password". This field is proposed to use it despite it is not necessary in LOM-ES. And it is expected that coexists seamlessly with the keywords that describe the focus of the learning object, allowing search by tags related to the topic of the object and the skills sought.

Following the case of adds, the classification of competencies suggested, would allow one hand, improve the localization and adaptation of repository objects in the high school area, offering items that aim to facilitate the acquisition of core competencies in the subsequent studies grade. On the other hand, would improve the location and alignment of objects in the repository to the skills demanded in the business, making people more suited to the requirements of the employability processes.

Finally, the proposal could provide the mechanics of teaching a simple labeling that largely avoid uncertainty by providing templates for help.

5. ACKNOWLEDGMENTS

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