

Design Experiences with the Learning Objects Board System

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Abstract

Repositories of learning objects are increasingly becoming available on the Internet. The quality of the learning objects that they store as well as the mechanisms provided to easily find them for reusing are very important. Learning Objects Board (LOB), built around the “stock exchange” metaphor, brings a new concept of Learning Objects Repositories pushing users motivation to produce good learning objects as well as increasing the cooperation between users either by submitting suggestions, comments or rating existing learning objects. To achieve such high level of motivation and interest some kind of healthy competition is promoted, assigning credits to users and setting a value cost for each learning object. This credit-based system allows the creation of users and learning objects rankings, and consequently permits reward those users that collaborate by creating LO or by adding valuable information to the existing LO, and increases the value of the most popular LO. This paper presents the major results from the design experiences that have been developed during the LOB implementation phase. Finally, the paper discusses some open issues and future work.

1 Introduction

The prosperity of the countries depend upon the knowledge and skills of their workforce[1]. It is worldwide accepted that investments in education and training are critical factors in their competitiveness. The need and usefulness of online learning is today no longer in question [2] and the increasing popularity of e-learning has brought into focus the desirability and in some cases the necessity of breaking up learning material into reusable parts called “Learning Objects” (LOs) [3].

LO is defined as “any digital resource that can be reused to support learning” [4]. LOs must have among others the following qualities: accessibility,

interoperability, adaptability, reusability, durability, and granularity. The principal idea is to share LOs by producing them centrally and use them in different courses. The fact of being digital resources means that they can be distributed easily through electronic ways such as the Internet. LO Repositories (LORs) are platforms that provide persistence, searching and access control features [2]. Describing a LO with metadata allows it to be understood by both humans and machines in such ways that promote interoperability, such as [5]: (1) LOs to be found by relevant criteria; (2) identifying resources; (3) bringing similar resources together; (4) distinguishing dissimilar resources; and (5) giving location information.

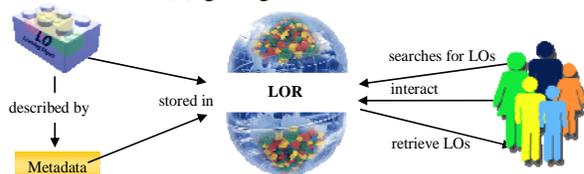


Figure 1. Generic LOR that stores both LOs and metadata.

LORs are increasingly becoming available on the Internet. Figure 1 represents a generic LOR that stores both metadata and LOs. Repositories that hold LOs should have user interfaces and architectures that turn them easy to use and with various levels of interactivity including search, submission, reviewing, and creating personal collections. Different LORs try to address different needs. Therefore, different LORs can select some metadata elements as well as their related value sets from one or more metadata standards [6]. The specification of these metadata elements and value sets is called as “application profile”, which are used to adapt metadata specifications to the requirements of the local community such as multilingual and multicultural requirements [7].

As a result of the experience gathered from previous analysis on existing LORs (such as MERLOT, EdNA,) we recognize that the number and the quality of LOs are key issues for the LORs popularity [8]. Those issues can be detailed in the following questions: How

can we keep people interested and motivated for producing LOs in number and quality? How do we promote collaboration between users? How can we reward users that create LOs and cooperate for the LORs popularity? How can we get value from those that retrieve and use LOs? With all these issues and questions in mind, we propose a system that solves some of the classical difficulties and that promotes users to produce and consume LOs, cooperating together, involving them in most of the LOR's functionality, rather than being mere consumers, retrieving LOs and leaving LOR.

In this paper we describe the LOB (Learning Objects Board) system, which proposes a novel approach to cope with the issues mentioned above.

The main idea of the LOB system is built around the "stock exchange" metaphor [9-11]. Each LO has a dynamic price or a value (in credits) that oscillates along its lifetime depending on user interactions. Users gain credits when they submit, evaluate LOs or add valuable information to existing LOs, or when they participate in some other LOB functionalities. This amount of credits gained allows users to retrieve LOs, but also provides a way to evaluate the users level of cooperation. The interest of design and support a LOR that follows the proposed credit-based approach is one innovative way to promote users collaboration, as well as keep authors with high levels of motivation to create good LOs, instead of having from the very beginning large budgets to pay interdisciplinary teams for creating those LOs. A credit-based LOR, like the proposed LOB system, can be implemented in different contexts such as schools, universities, enterprises, community of practices, because, we believe, it promotes the motivation, cooperation and collaboration among a large number of involved stakeholders.

This paper provides a comprehensive overview of the LOB system and, in particular, describes the experiences that have been done during its design and implementation phase.

Section 2 overviews the main idea, processes and use cases supported by the LOB system. Section 3 presents the design experiences that have been developed and describes its main architectural and design aspects. Section 4 refers the related work regarding LORs platforms and briefly discusses the distinct aspects of the LOB system. Finally, Section 5 presents the conclusions, the followed research methodology, future work, and possible application areas of the LOB model.

2 LOB Overview

LOB is a LO Repository with new and with specific features with the aim to maximize authors and end-users participation, without the need to spend large amount of money paying teams to produce LOs. Like all repositories, LOB is a Web site where users submit and retrieve LOs and respective metadata. LOB metadata application profile is based on the Dublin Core metadata [12]. It provides search features where users can search inside LOB to get a list of LOs matching the search criteria defined with some metadata values description, category or authors information. Only registered users can access restricted information, like comments, ratings, forum, user instructions and peer reviews. The process of registering is easy and free of charge. The users just need to fill in a form with some personal data, submit it and activate the account later. By activating their account, user receives automatically a specific amount of credits that allows instant opportunity to use the LOB system, for instance to retrieve LOs.

2.1 Main Processes

Based on the stock exchange metaphor, the LOB model permits to understand fairly how much users are collaborating, as well as a way to keep changing the value of LOs depending on user interactions and interests, promoting more popular LOs and demote other LOs. The aim is grant the LOs excellence through an open and competitive environment. Each LO has a value calculated by a specific formula (described in the next section) so, when a user wants to retrieve a LO, he need to spend that credit amount. We believe that other issues come along, for example: What should be the initial value of LO? and How can users acquire credits?

The process of submitting LOs is allowable to any registered user. Each LO can have more than one author. When a user submits a LO, he needs to introduce all authors names, its relative ownership percentage, and indicate which will be responsible for that LO. He also needs to enter the metadata and set two values for the LO: its initial and minimum acceptable values. Only users that are assigned to be responsible for a specific LO are allowed to change the metadata information and the minimum price. This process of creation, cataloguing and setting values is suggested in Figure 2.

After submitting the LO, it is assigned automatically to a reviewer which is in charge for approving or rejecting it. After the LO approving, the reviewer is

responsible for rating it and write a review that will be associated to that LO and that can become available to all registered users. On the other hand, if the LO is not accepted, the reviewer contacts the author with suggestions for improving LO quality and or for changing the related cost, as we can see in Figure 3. The evaluation values should be done by reviewers and should be based on LOs quality, and some other previously accepted criteria like. Registered users increase their own credits by doing different operations, such as creating LOs; commenting; rating; describing instructions or good practices for using LOs or writing suggestions for existing LOs.

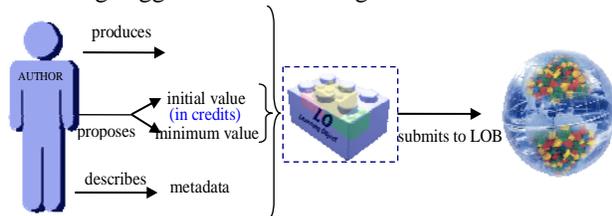


Figure 2. LO Submission Process

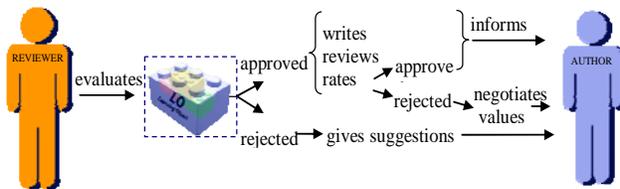


Figure 3. LO Evaluation Process

Once published, all information associated to the LOs is available to all users providing them several features, as suggested in Figure 4, such as searching, browsing and viewing LOs and their related information.

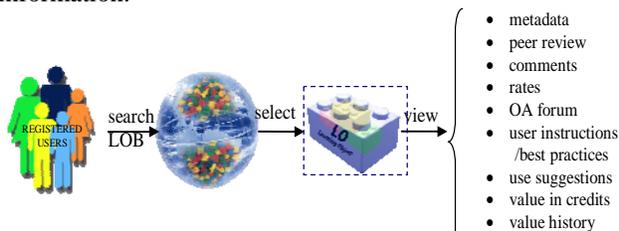


Figure 4 LO Retrieval Process

Registered users can increase their own credits by doing different operations, such as creating LOs; commenting; rating; describing instructions or good practices for using LOs or writing suggestions for existing LOs.

2.2 Actors and Use Cases

There is a hierarchy of actors supported by the LOB system which is represented in Figure 5.

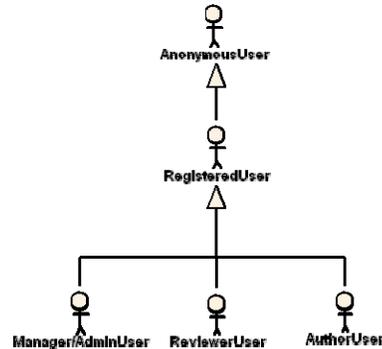


Figure 5. Hierarchy of actors supported by the LOB

Below, we summarize the most relevant use cases grouped by actors. Some use cases have direct impact on the credit-base system either on user credits alone or on both user credits and LO value.

AnonymousUser represent any user that is not registered in LOB and is involved in the following use cases: LO searching (none impact); and LOB register (impact on user credit).

RegisteredUser represents users that are registered in the LOB, already logged in, and are involved in the following use cases: LO purchasing (impact on both user credit and LO value); LO viewing associated information (none impact); Specific LO request (none impact); Alerts subscription (none impact); Personal Collections Creation (none impact); Abuse Reporting (could impact on user credits by penalizing user that committed the abuse); LO collaboration offering (none impact); Request LO collaboration (none impact); Helping users (impact on user credits); Helping asking (none impact); LO comments submission (impact on user credits); LO suggestions submission (impact on user credits); LO rating (impact on user credits); Credits purchase (impact on user credits).

AuthorUser is a registered user that creates LOs and is responsible for them. AuthorUsers can do: LO submission (impact on both user credit and LO value); Metadata registration (none impact); Metadata edition (none impact); LO setting values (impact on LO value); LO promotions (impact LO value).

ReviewerUser is also a registered user, with the additional responsibility for accepting LO. ReviewerUsers can do: LO reviewing (none impact); LO acceptance (impact on both user credit and LO value); LO recommendation for awards (none impact); LO rating (impact on LO value); LO values

negotiation (impact on LO value); LO suggestions submission (none impact).

Manager/AdminUser is the user in charge for setting values and configuring the LOB system, and is involved in the following use cases: Competition creation (impact on user credits); Lucky draw creation (impact on user credits); LO topic promotion (none impact); LO Award setting (impact on user credits); configuring values in the settings tables.

3 LOB Design Experiences

This section presents the major decisions taking into account during the design and implementation phase of the LOB system.

The Figure 6 shows a screenshot of the LOB's initial Web page after the user login.



Figure 6. LOB initial screenshot after user login

3.1 Top-Level View

The LOB system is being implemented according a modular, iterative and incremental approach in order to start testing the system as soon as the main features are implemented. Each individual feature is implemented in separate modules on top of the WebComfort platform. WebComfort is an ASP.NET-based content management system (CMS), that provides the following features [13, 14]: (1) content and presentation separation; (2) extensibility through modules developed as need; (3) authorization and security policies based on a flexible role-based approach; (4) content operation features such as (i) content referencing; (ii) content copy; (iii) XML content import and export; (4) online visual style editor; (5) webparts technology integration; (6) multi-language support; and (7) content search support LOB LOs and Associated Information.

Figure 7 represents the LOB high-level architectural view, with the main modules that are being developed in the first LOB implementation iteration.

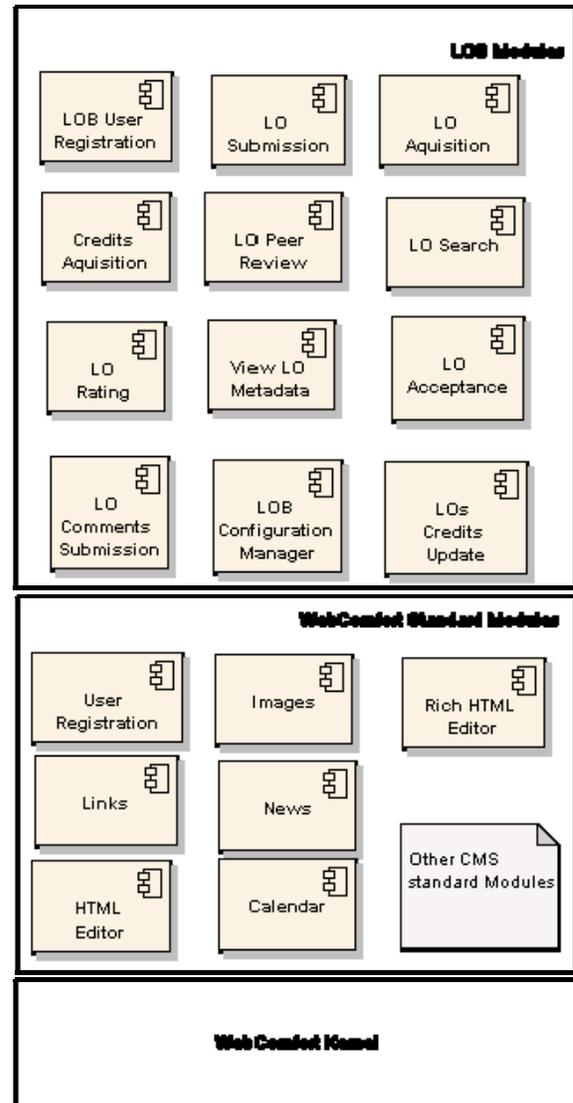


Figure 7. LOB high-level architectural view

3.2 Users and User-Credits Management

Concerning users, LOB supports its registration and the user-credits management.

LOB USER REGISTRATION module is the responsible for detecting if the user is a registered LOB user or not. If so, it shows its information, the number of credits that it has, permit to change its personal data, and allows buying more credits. If it detects that it is not a LOB user, it ask for the LOB registration.

By making LOs submissions or by performing some other LOB operations, users can increase their credits amount. This user-credit management is implemented

inside each particular LOB operation module as follows.

Whenever a user submits a LO he earns specific amount of credits. Whenever users buy LOs their authors earns credits. The amount of credits earned depends on the value assigned made by the reviewer and is calculated rated according the percentage of authoring. These values are set by the LOB's manager, by filling in a table with the ratings (in a scale ranging from 1 to 5) and the correspondent weight. LOB's manager is also responsible to pick out some topics based on user requests for example, to encourage the creation of LO matching that topic. Users that submit LO for those topics are rewarded with a number of credits, specified by manager for each topic.

Whenever users buy LOs, they can perform some tasks in order to earn more credits; for example: commenting; rating; describing instructions or good practices for using LOs or writing suggestions for existing LOs. This can be viewed as adding extra-value, important to LOB users. Those tasks are obviously other ways to earn credits. The values of credits for each action are set by the manager when configuring LOB's rules and can be tuned when needed. With this information, is easy to figure a user history that allows ranking users depending on their collaboration. In some context these statistics are important to promote a kind of a healthy competition between users encouraging them to collaborate more and better.

There are other LOB features, in which users can earn credits, for instance: a lucky drawn of credits made every month among the users that spent or obtain credits; LOs creation competitions; or by LO prizes recognition. One last but not least option for those without credits: it should always be possible to buy credits with money (the exchange value for credits is set by LOB's manager)!

3.3 LO Value

An important research issue that addresses the LOB system is: how can we determine the right LO value? In the current research we proposed a dynamic value determination, based on the stock exchange metaphor and determine on a set of related formulas (see Table 1, at Annex). The initial value of LO is set by its authors. Depending on the reviewers rating this value is tuned, and LO value changes dynamically according to purchases according to the formulas and the values defined by manager in LOB configuration Table.

It is important to note that the value of LO can not be less than the minimum value given by the author. If,

for instance nobody is interest in a given LO, its responsible author can always set a new minimum value. Based on LO values and its variation, it is possible to calculate LOs that have the higher raise, calculate the LOB value and its variation, and compare daily or monthly transactions, allowing managers to anticipate and take adequate measures to motivate users and keep LOB popularity.

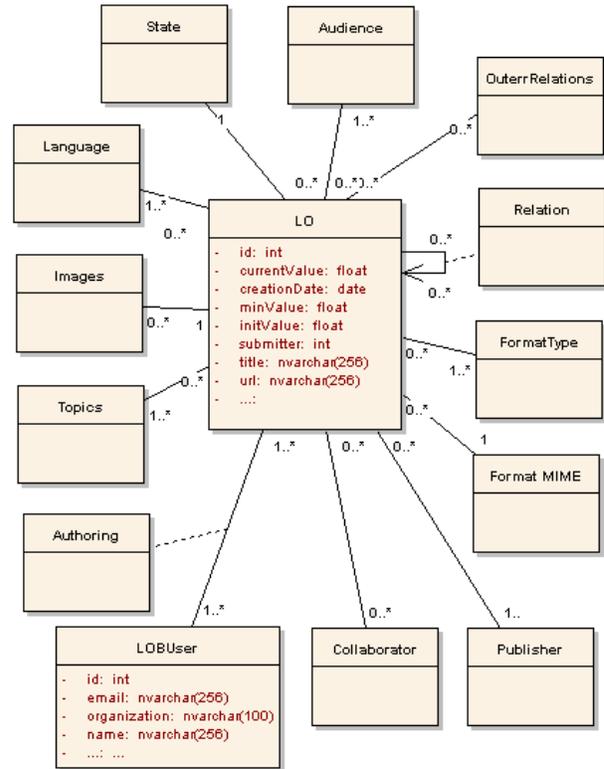


Figure 8. LO and metadata definition model

3.4 LO Features

LO SUBMISSION module is responsible by LOs submission as well as their respective metadata registration, as shown in Figure 9.

The metadata application profile is based on Dublin Core Metadata Initiative [12] and is represented in Figure 8.

LO ACQUISITION module allows end-users to buy one or more LOs. LO-value and User-credits affected by each acquisition are calculated and updated by this module.

CREDITS ACQUISITION module permits end-users to buy credits if they don't have enough to acquire LOs.

LO PEER REVIEW module is available to the reviewer-users; list all LOs that the user needs to

perform the reviewing; allow to write the revision and submit it to the authors.

LO SEARCH module provides mechanisms that allow users to find LOs under specific criteria and view a subset of metadata values, like description, authors and date of creation.

LO RATING module lists all LOs bought by the user and provides a form to rate it.

VIEW LO METADATA module allows users to view metadata of a specific LO, or even update the values if the user is the responsible user for that LO.

LO ACCEPTANCE module lists all LOs that are available to be accepted or rejected depending on the

reviewers' opinion. This module is available to the LOB administration only.

LO COMMENTS SUBMISSION module LOs bought by the user and provides a form fill in LOs comment.

LOB CONFIGURATION MANAGER module is available to the LOB administrator, and provides setting mechanisms configure LOB features and operations credit-values.

LOS CREDITS UPDATE module is the only one that doesn't require user interaction. This module is integrated in the system and is in charge of updating the values automatically, every day, depending on the LOs and acquisitions.

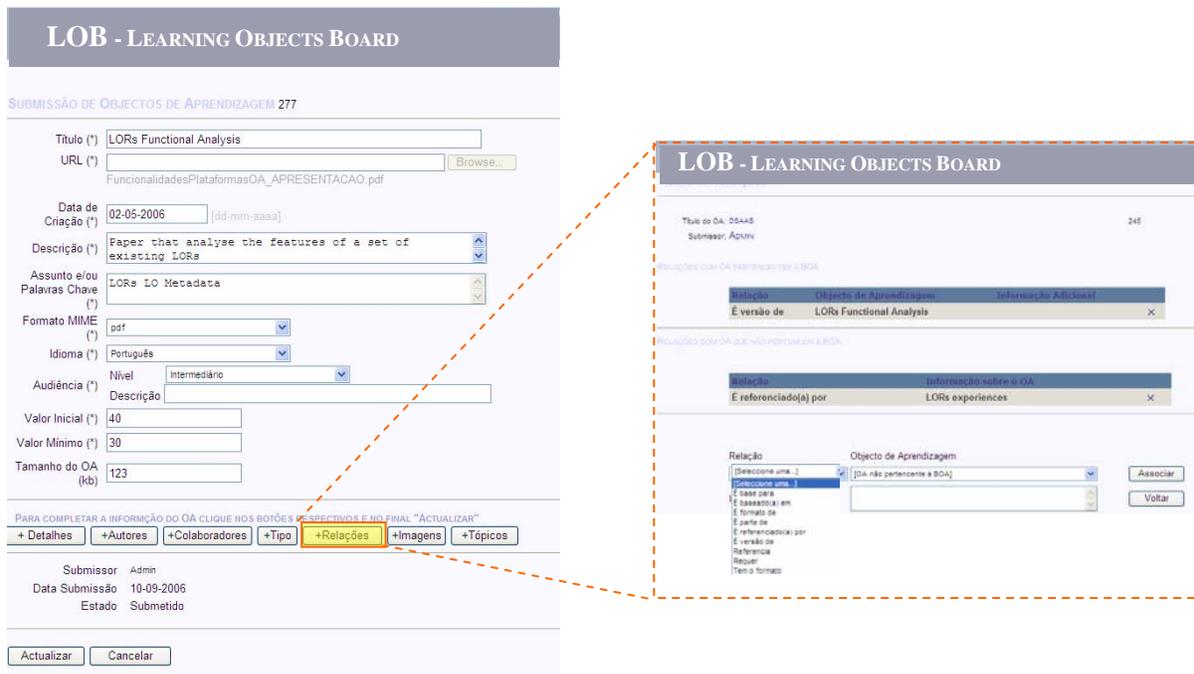


Figure 9. LOB submission and metadata registration

3.5 Collaboration Features

Complementarily to the creation and production processes, users can also interact and collaborate among themselves to improve their knowledge or by allowing them to express their LOs needs. The features presented below are created to keep users informed, motivated and to collaborate more frequently, and are obviously associated to every LO or a set of them in general.

These features will be implemented as independent modules in the next LOB iterations.

Promotional LO: Users can create promotions for their LOs by setting a lower value and the duration for

that promotion. During that period of time the value of LO doesn't change and when the promotion is over LO value should be the same that it was before the promotion. Its authors continue to earn credits for each purchase.

Cooperation Area: An area where authors can ask and or provide different kinds of knowledge to cooperate in LO authoring. For example, one user is good dealing with animating tools but knows nothing about the structure of human skin. He can ask any user if they want to cooperate with him to create a LO where he will be responsible to design and the other will be responsible for the technical aspect of that topic.

Helping Area: An area where users can post questions and answers and some sort of help of any topic. This space could be accessed and viewed by any registered user and it is monitored by LOB's manager. He is also in charge to give credits to users that provide good helping answers to posted questions.

Abuses or Faults Reporting Area: An area provided to report abuses of different kinds: comments or bad use of LO. LOB manager can penalize users for it. The reason for providing this area is essentially for discouraging users to commit abuses or faults for intellectual property and copyrights policies. These kinds of issues are always difficult to control. LOB can force users to agree and respect copyrights policies but probably the existence of this area could be a better way to encourage users to respect intellectual property. Different kind of work has been done around the intellectual property rights, but most of the times unsuccessful. It is important to realize that the respect for intellectual property rights is always in the hands of end users.

LOs Request: An area where users can ask for specific LO. Manager can use those requests to promote LO topics.

LOs Awards: Created in order to promote and recognize outstanding LOs. LO value will increase, based on the weight set by LOB manager, their authors will receive extra credits, and awarded LO will be listed together with the award symbol.

LOs Newsletter: LOB publishes a digital newsletter with LOs information.

LOs and Users Rankings: User rankings will be created to represent the most valuable collaborators, calculated by adding all credits earned by each user. Rankings for LO will also be available in order to highlight those that for some reason have more purchases, quality or value.

Credits Lucky Draw: A lucky draw for credits is done between all users that earn or spent credits in LOB since the last lucky draw.

LOs Competition: Made to create more dynamism around LOB and encourage users to create outstanding LO for specific topics.

Alerts Subscription: Users can subscribe different kinds of alerts: LOs notifications, LOs comments or other LOs interactions and competitions announcements.

Create Personal LOs Collections: Created to allow users to organize their LOs to facilitate and speed up its access.

4 Related Work

In a initial work we researched and analysed existing LORs, in particular MERLOT, ARIADNE, EdNA, CAREO, WISCONSIN and SMETE [15-18] with the aim to capture their common features, understand their business and functional models [8]. That analysis focused on the following issues: who create LOs, end-user motivations, LOs prices, types of searches provided, and the kind of LO information that is returned after a search is made and how users retrieve LOs. Most of the analysed LORs are founding by Universities, Foundations or Government Initiatives, so it is understandable that users don't have to pay for the access to their LOs, and that the number of existing LOs tends to be high, due to the contribution of teachers or other instructional users involved in most of the cases, in those projects.

More information on these analysis can be obtained from the referred paper [8]. However, Table 2 summarizes the proposed LOB features and compares them against the analysed LORs (see Table 2, at Annex).

Among different considerations it should be stressed that the LOB system, in comparison with other LORs systems, proposes unique features due to the innovative credit-based approach and its strong idea of promote users involvement and collaboration in a competitive but open environment.

5 Conclusions

Providing LORs with a credit-based approach is the innovative proposal of this paper. We believe this approach can be suitable for different scenarios because it better promotes the motivation and collaboration of the LOs authors, and especially when LORs don't have a substantial funding support. We thought in new features to keep users motivated and, specially, a way to reward those who author LOs and others who use LOB frequently. When a user purchase a LO he can recover some of its investment just by rate, comment and provide other information that will be relevant to others users. This kind of interactions is important to maintain LOB dynamic and popular. Other important fact is that LOs values are always changing, creating user's interest to enter LOB everyday to check LOs values and promotions. We think that using this credit-base system together with rankings, users would enjoy it as an open and healthy competitive environment.

5.1 Methodology and Future Work

We followed a scientific methodology to support our research, typically the kind of methodology followed in the area of IT engineering based on the following activities: state of art analysis; problem statement; solution statement; design and implementation of a preliminary version of the system (e.g., a functional prototype); evaluation; refinement; and conclusion.

We started by analyzing the LOs and LORs state of art. Based on the analysis made we find out the most common and popular LOR features, as well the respective strengths and weaknesses. We realized that LOs creation and end-users involvement is of crucial importance for the LOR success. In this context, we proposed the LOB model, following the stock exchange market metaphor, and proposed the design and implementation of the LOB system to fulfill user interaction, motivation and interest by changing LOs values dynamically.

To test and evaluate LOB suitability, it will be applied in a controlled group of teachers and students, in a K-12 school context. That preliminary experience will give feedback and extra material support to be used in classroom or at homework. Some of these teachers are in probation to become full k-12 teachers, so it is very important for them to create good LOs, share them, reuse existing LOs, and get feed back from other experienced teachers. We think this small context would permit to evaluate and test this system, getting feedback from different kind of people (from K-12 students to teachers in different professional degrees). During this period, LOB strengths and weakness will be evaluated. Feedback about the usefulness, available features and usability of LOB will be reached by doing different types of questionnaires to the users together with usability tests.

New iterations of LOB system will be developed to test and deploy the system into different application domains, as referred above. Furthermore, it could be defined in future work a “LOB methodology” to help its deployment, configuration and evaluation in different usage scenarios and domains.

Finally, statistical analysis should be done to evaluate user cooperation and the success of this credit-based approach.

5.2 LOB Application Domains

LOB can be applied in different contexts and usage scenarios: for example in educational environments (e.g., courses, schools, clusters of schools, universities,

and companies), communities of practices, or knowledge management communities. In **educational environments**, teachers would provide LOs and students would be responsible for interacting with those LOs, providing comments or even being allowed for creating and submitting their own LOs to be evaluated by reviewers (e.g., teachers) and other end-users (e.g., classmates). For **communities of practices** or **knowledge management communities** – like those involved in specific topics such as literature, culture, software development, project management, etc. – LOB can be adopted to support worldwide collaborations, sharing best practices and experiences, dissemination of that knowledge, and so on and so forth.

On the other hand, in spite it is in general preferable to implement LOB in narrow and controlled communities due to the number of users and other organizational issues; it is also possible to apply this approach in more uncontrolled communities, such as those accessible via Internet, with thousands of end-users.

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Annex

Table 1. Formulas used by the process of LO Valuing.

	Formula	Description
V1	LO-InitialValue	LO value defined by authors and accepted by reviewer
V2	LO-EvaluatedValue = $V1 + (V1 * ReviewerRate)$	LO value after rated by reviewer
V3	In the first day that LO is available to users $V3=V2$ Each day LOs values are updated depending on the number of eve purchases:	
V3a	LO-CurrentValue= $V3 + (V3 * NumberOfEvePurchases)$	LO current value, in case number of eve purchases > 0
V3b	LO-CurrentValue= $V3 - (V3 * AbsenceOfEvePurchase)$	LO current value, in case number of eve purchases = 0

Table 2. LOR functionalities comparative table

Feature \ LOR	LOB	ARIADNE	MERLOT	CAREO	WISCONSIN	EdNA	SMETE
Search LO	✓	✓	✓	✓	✓	✓	✓
View Metadata	✓	✓	✓	✓	✓	✓	✓
Export Metadata	✓	✓	✗	✓	✗	✗	✓
Free access to LO	✗	n.a	✓	✓	✓	✓	✓
Hierarchical topic navigation	✓	n.a	✓	✓	✓	✓	✓
Submit Metadata	✓	n.a	✓	✓	✓	✓	✓
Edit Metadata	✓	n.a	✗	✓	✗	✗	n.a
Submit LO	✓	✓	✓	✓	✓	✓	✓
Accept LO	Needs Approve	n.a	Automatic	Automatic	Needs Approve	Needs Approve	n.a
Comment LO	✓	n.a	✓	✓	✓	✗	✓
Peer Review	✓	✗	✓	✗	✗	✗	✓
Reviewer Rate LO	✓	n.a	✓	✗	✗	✗	✗
User Rate LO	✓	n.a	✓	✗	✓	✗	✓
LO Forum	✓	✗	✗	✓	✗	✗	✗
LO awards	✓	n.a	✓	✗	✗	✗	✗
LO best practices	✓	✗	✓	✗	✗	✗	✗
Alerts Subscription	✓	✗	✗	✗	✓	✗	✗
LO competition	✓	✗	✗	✗	✗	✗	✗
LO and Metadata Storage	Both	Only Metadata	Only Metadata	Metadata and some LO	Both	Only Metadata	Metadata and some LO
Report Bad Use	✓	✗	✗	✗	✗	✗	✗
Area to find collaborations	✓	✗	✗	✗	✗	✗	✗
Helping Area	✓	✗	✗	✗	✗	✗	✗
Create personal collections	✓	n.a	✓	✓	✓	✗	✓