

The Learning Objects Board System

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Abstract: Repositories of learning objects are increasingly becoming available on the Internet. The quality of learning objects that they store as well as 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 cooperate with other users either by submitting suggestions, comments or rate existing learning objects. To achieve this high level of motivation and interest some kind of competition is promoted, assigning credits to users and setting a value cost for each learning object. This credit-based system allows creating users and learning objects rankings, rewarding those that collaborate with the system, and getting values from those who use LOB.

1. Introduction

The prosperity of the countries depends upon the knowledge and skills of their workforce (McGreal 2004). 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 (Downes 2004) 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) (Doorton, Giesbers *et al.* 2004).

LO is defined as “any digital resource that can be reused to support learning” (Wiley 2000). LOs must have among others the following qualities: accessibility, interoperability, adaptability, reusability, durability, and granularity. The main 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 means such as the Internet. LO Repositories (LORs) are platforms that provide persistence, searching and access control features (Downes 2004). Metadata is structured information that describes, explains, helps to locate, or otherwise makes it easier to retrieve, use, or manage an information resource. Describing a LO with metadata allows it to be understood by both humans and machines in ways that promote interoperability, allowing: (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 (NISO 2004).

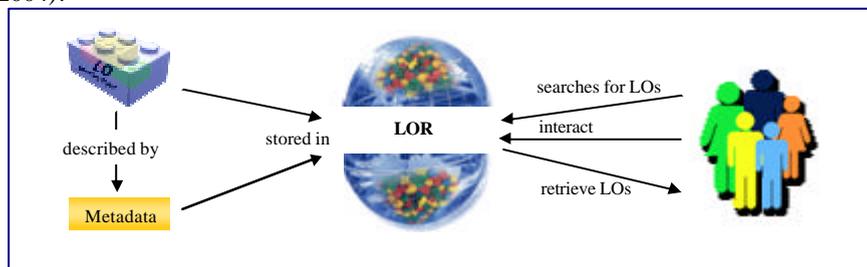


Figure 1 Generic LOR that stores both LOs and metadata.

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 make 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 (Heery and Patel 2000). The specification of these metadata elements and value sets is called “application profile”, which are used to adapt metadata specifications to the requirements of the local community such as multilingual and multicultural requirements (Duval, Sutton *et al.* 2002).

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 (Silva and Silva 2006). 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 prosperity? 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 spectators, 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 (Samuelson and Nordhaus 1999; Levinson 2003; Mishkin 2003). 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 create or evaluate LOs, or when they cooperate with the LOB, or in some sort of other existing 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 designing and supporting a LOR that follows the proposed credit-based approach is one innovative way to promote users collaboration, as well as keeping authors with high levels of motivation to create good LOs, without the need to have from the very beginning large budgets to pay for interdisciplinary teams to create those LOs. A credit-based LOR, like the LOB system, can be implemented in schools, universities, enterprises, community of practices, because, we believe, it promotes the motivation, cooperation and collaboration among a large number of stakeholders involved.

This paper provides a comprehensive overview at the LOB system. Section 2 overviews the main idea and functionalities of LOB. Section 3 describes LOB LOs and associate values, together with some LOB features. The most important and innovative concept of the credit-based system, users and LOs values are presented in section 4. Section 5 presents other initiatives and a comparative analysis regarding LOB. Finally, section 6 presents the conclusions.

2. LOB Overview

LOB is a LO Repository with extra functionalities, features and concepts with the aim to maximize end-users and authors participation. Like all repositories, LOB is a Web site where users submit and retrieve LOs and metadata. It provides search features to allow users finding the appropriate LOs that match their needs. 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.

Gathering and preserving users motivations, collaboration and enthusiasm are crucial for the success of LORs. These will interfere either on the quality of LOs stored as well as producing LOs that matches the user’s needs. Not only the creation of LOs is important but also important is getting user’s feedback from their experience.

This 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 relegate the others, which means promoting, through an open and competitive environment, the IOs excellence. Each LO has a value calculated by a specific formula (described in the section 4) so, when a user wants to retrieve a LO, he needs to spend that credit amount. We believe that two questions come along naturally: What should be the initial value of LO? How can users acquire credits?

The process of submitting LOs can be allowable to any registered user. Each LO can have more than one author, but only one will be its responsible. When a user submits a LO, he needs to introduce all authors names, its relative ownership percentage, and the one that 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. 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 writing a review that will associated to the 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 changing the related cost, as we can see in Figure 3. 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.

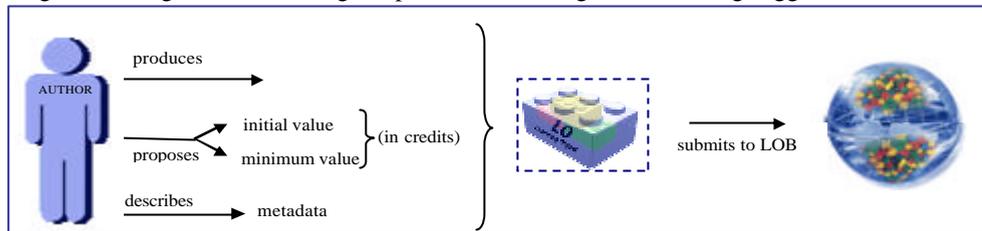


Figure 2 LO Submission Process.

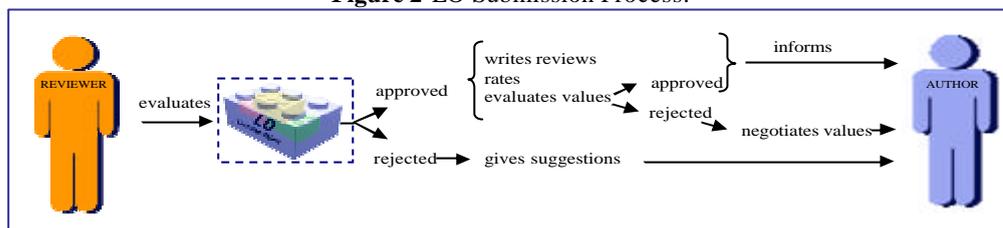


Figure 3 LO Evaluation Process

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.

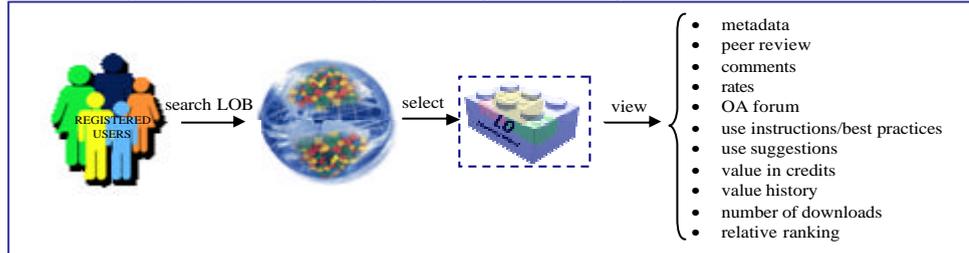


Figure 4 LO Retrieval Process

Registered users 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.

There is a hierarchy of actors supported by the LOB system, namely the *AnonymousUser*, *RegisteredUser*, *AuthorUser*, *ReviewerUser* and the *Manager/AdminUser*. We summarize below 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* represents any users 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 any user that is registered in the LOB and is already logged in and is 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 penalising user that committed the fault or abuse); LO collaboration offering (none impact); LO collaboration asking (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 on user credits).

- *ReviewerUser* is also a registered user, with the additional responsibility of accepting the 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 of setting values and configuring the LOB system, and is involved in the following use cases: Competition creation (impact on user credits); Draw creation (impact on user credits); LO topic promotion (none impact); LO Award setting (impact on user credits); and Weights and features setting (impact on both user credit and LO value).

3. LOB LOs and Associated Information

As represented in Figure 5 LOs are characterized by several attributes such as current-value, minimum value, state, and described dynamically by metadata elements. LOs and their associated metadata description are stored in one or more files accessible through common URL mechanism

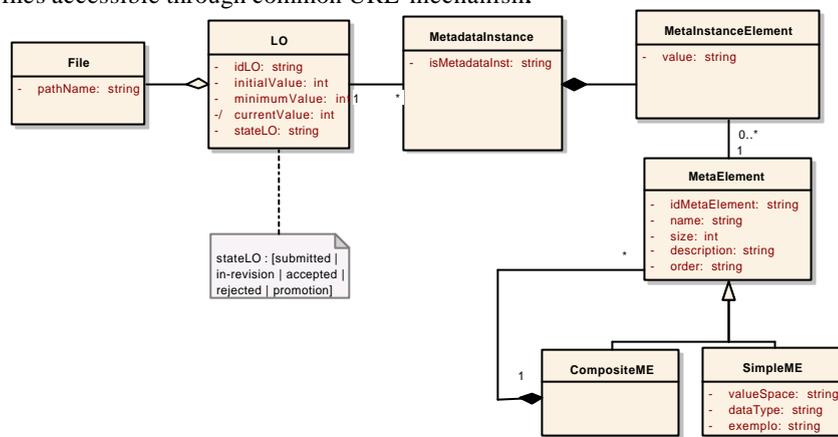


Figure 5 The LOB's LO definition

Figure 6 represents LOB's LO credit-based support where each user can have more than one role associated and can perform some LOB operations already summarize in the previous section, some of them influence directly LOs and/or Users credits. Users are responsible for authoring LOs defining initial values and ownership percentages.

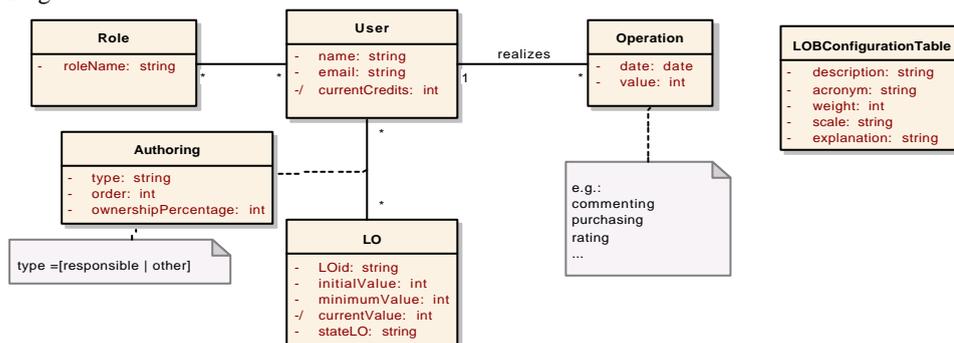


Figure 6 The LOB's LO credit-based support

3.1 LOB 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 were 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.

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 of giving 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 kinds of work have been done around the intellectual property rights, but most of the times unsuccessfully. It is important to realize that the respect for intellectual property rights is always in the hands of the 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 the 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.

3.2 Finding the appropriate LO

The LOB initial page can show dynamically relevant data, such as , last submitted and most purchased LOs. Users can make simple or advanced searches. Simple search is done by the use of keywords; advanced search is done using metadata fields like author, date of submission, topics and rates. An optional way to access LO is using hierarchical navigation through a tree of topics.

The return of search operation is a list of LOs with the following information: name of LO, author, date of submission, reviewer rate, user rates, description, topic and subtopic, LO value, and the number of purchases. Navigating through the LO's links, all associated information is available, like comments, instructions, peer review, metadata information, access to forum.

4. Valuing – User Credits and LO Value

In this section we describe the LOB features, especially those related to the credit-based system. Starting by explaining how users gain credits and how the cost for LO is calculated, the major features are briefly explained.

4.1 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.

The initial value of the LO is set by its authors. Depending on the reviewers rating this value is tuned, and LO value changes dynamically according to purchases as described in the formulas (see Table 1) and the values defined by manager in LOB configuration Table (see Table 3):

	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 1 LO calculation value formulas

For a better understanding of Table 1 a scenario will be represented in Table 2 for exemplifying the above formulas and calculations.

Operation	Formula	Description	Calculation	LO Current Value
LO submission	V1	Initial LO value	35	35
Reviewer Rate 4	V2	LO-EvaluatedValue	35 + (35 * 4*10%)	49
1 ^o day (5 purchases)	V3	LO-CurrentValue	49 + (49 * 5 * 5%)	61,25
2 ^o day (2 purchases)	V3	LO-CurrentValue	61,25 + (61,25 * 2 * 5%)	67,38
3 ^o day (0 purchases)	V3	LO-CurrentValue	67,38 - (67,38 * 5%)	64,01

Table 2 LO calculation value scenario.

It is important to note that the value of LOs can't be less than the minimum value given by the author. If, for instance, nobody is interested 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 (e.g. sum of all LOs values) and its variation, and compare daily or monthly transactions, allowing managers to anticipate and take adequate measures to motivate users and keep LOB popularity.

Description	Target	Value	Weight	Measure	Explanation
Reviewer Rate Value 1 or 2	LO	1..2	0	Percentage	Rate Value 1 or 2
Reviewer Rate Value 3 -5	LO	3..5	10	Percentage	Rate value 3, 4 or 5
User Credits from Review	USER	1..2	10	Credits	Review Rate * weight
User Credits from Review	USER	3..4	15	Credits	Review Rate * weight
User Credits from Review	USER	5	20	Credits	Review Rate * weight
Penalization	USER		10	Percentage	User credit penalization by LOB fault or abuse
LO Topic interest	USER	1..3	25	Credits	Topic interest value * weight
LO Rating	USER		5	Credits	User gain 5 credits for rating LO
LO Commenting	USER		15	Credits	User gain 15 for commenting LO
Credits Lucky Draw	USER		100	Credits	Amount of credits drawn
LOs Purchase	LO		5	Percentage	For each LO purchase LO value increases 5%
Absence of daily purchase	LO		5	Percentage	Each day without purchases LO value decreases 5%
LOs Purchase	USER		10	Percentage	For each purchase user collects 10% of LO value

Table 3 LOB configuration table

4.2 User credits

Whenever a user submits a LO he earns a specific amount of credits. Whenever users buy LOs their authors earn credits. The amount of credits earned depends on the value assigned by the reviewer and is calculated rated according to 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. The LOB's manager is also responsible of picking out some topics based on user requests, for example, to encourage the creation of LO matching that topic. Users that submit LOs for those topics are rewarded with a number of credits, specified by the manager.

Whenever users buy LOs, they can perform some tasks in order to earn 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. Table 3 represents an example where a manager sets the actions and values of credits assigned to the users, or percentages that will be used to calculate the LO's value.

With this information, it 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 draw of credits made every month among the users that spent or obtained 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)!

4.3 Other User interactions with LOs

Associated to every LO is a specific LO-forum, where users can get appropriate answers to their doubts concerning that LO. LOs responsible is also the responsible for LOs forum, however he can delegate that task in another user.

5. Related Work

In a previous work we researched and analysed existing LORs (Silva and Silva 2006). In particular, we analysed (ARIADNE; CAREO; EdNA; MERLOT; SMETE; WISCONSIN) with the aim of capturing their common features, understanding their business and functional models, such as who creates LOs, 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 these LORs are financially supported by Universities, Foundations or Government Initiatives, so it is understandable that users don't have to pay for the LOs, and the number of existing LOs is high, in most cases, due to the contribution of teachers or other instructional users involved in the project in most of the cases. Table 4 lists LORs relevant features and their presence or absence for each analysed LOR.

LOR \ Feature	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 MetadataStorage	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	✓	✓	✓	✗	✓

Table 4 LORs functionalities comparative table.

More information on these analysis can be obtained from the referred paper (Silva and Silva 2006). However, most important than discussing the unique features proposed by the LOB system (as evident from table 2) is to stress its innovative credit-based approach.

6. Conclusions

Providing LORs with a credit-based approach is our innovative proposal in this paper. We believe it is more suitable because it better promotes the motivation and collaboration of the LOs authors, and especially when LORs don't have a substantial funding support. User's contribution and cooperation are essential to its success. We

thought in new features to keep users motivated and especially in a way of rewarding 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 rating, commenting and providing other information that will be relevant to others users. This kind of interactions is important to maintain LOB dynamic. Another important fact is that LOs values are always changing, creating user's interest to enter LOB everyday to check LOs values and promotions. We hope that using this credit-base system together with rankings, users can enjoy it as an open and healthy competition environment.

LOB can be used in different contexts for example in a **course** where the teacher provides some LOs and each student is responsible for interacting with those LOs, providing comments or is allowed to create his own LOs and submitting to LOB to be evaluated by the reviewer (teacher) and other users (classmates). LOB can also be used in **communities of practices** like literature or music, LOB can be implemented to capture worldwide collaborations, sharing different cultures and experiences making. People that share specific topic interest, usually contribute with different kinds of knowledge that can be used together with others LOB users to create most valuable LOs. LOB can also be implemented to support **team collaboration** and **project managers** for a specific project or even wider, among different projects. Software developing companies can use LOB in order to **share software components** that they are developing, creating high levels of collaboration between designers, programmers, architects, managers and users helping each other with problems, have more users to perform testing, gathering suggestions, discussing strategies, and so on and so forth.

A different approach to LOB can be used by the educational sector, where teachers need to attend specific promoted courses. Each course has typically a number of credits assigned. Sometimes there is no interest in the courses provided in that year. Why not complement the existing current system with LOB where instead of just taking courses to get promotion, teachers can optionally collaborate by producing good LOs that can be evaluated and contribute to their career progression? Teachers from different disciplines can cooperate by spreading the creation of LOs to all disciplines. These LOs could reach all educational community (including students) and should be considered a most valuable contribution. It will be very easier to understand those teachers that are really contributing for better learning contents and helping students on their needs and weaknesses.

In spite, implementing LOB in specific contexts like schools or companies is preferable due to the number of users and organizational issues. It is always possible to spread this approach to all internet users without limits.

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