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Application Scenarios for the Learning Objects Pool

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Abstract: Learning Objects Repositories are becoming increasingly available on the Internet. Learning Objects Pool (LOP) built around the "stock exchange" metaphor, brings a new concept of Learning Objects Repositories pushing users motivation to produce good LOs as well as increasing the cooperation between users, either by submitting suggestions and comments or rating existing LOs. 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 LO. This credit-based system rewards users that collaborate by creating LOs or by adding valuable information. It consequently increases the value of the most popular LOs, and also allows the creation of users and LOs rankings. This paper provides a comprehensive overview of the LOP system and, in particular, describes some application scenarios where, through configuration and parameterization we show the LOP's high levels of versatility.

Keywords: Learning Object, Learning Objects Repository, e-Learning, Collaborative Learning
Categories: H.3.5, H.5.3, K.3.1

1 Introduction

The prosperity of countries depend on the knowledge and skills of their workforce [McGreal, 2004; Laviña, 2007]. It is accepted worldwide that investments in education and training are critical factors in their competiveness. The need and usefulness of online learning is today no longer in question [Downes, 2001; Manjón, 2007]. The increasing popularity of e-learning technologies are substantially contributing to greater production and dissemination of learning objects (LOs). The LOs are changing the way and methods of teaching and learning, from the fact that the Internet provides an environment for easy and ubiquitous access and yet propitious for a personalized learning [Martinez, 2000; Downes, 2001; Downes, 2004]. If we use the technological resources in the LOs reuse, we can modify their content, change their sequence of presentation, eliminate or add other LOs, and also provide to each student a customized set of LOs according to their special needs.

Despite the large number of LOs available on the Internet, their proper use depends on the ability of individuals to locate and retrieve the most relevant LOs and

convert them into knowledge [Hodgins, 2000]. The LO description through metadata, allows them to be understood by humans and computers in order to promote interoperability, such as: (1) ability to locate them according to different search criteria, (2) ability to identify them, (3) join or relate distinct LOs that share the same subject or the same course, or present some kind of similarity (4) distinguish dissimilar LOs, and (5) provide information about their location. Figure 1 represents a generic LO repository that stores both metadata and LOs.

Figure 1: Learning Objects Repositories Context

Repositories that store LOs should have user interfaces and architectures that turn them easy to use. They should offer various levels of interactivity including search, submission, reviewing, and publishing customized collections. Different LO repositories can select some metadata elements as well as their related value sets from one or more metadata standards [Heery, 2000]. The specification of these metadata elements and value sets is called "application profile", which is used to adapt metadata specifications to the requirements of the local community, such as multilingual and multicultural requirements [Duval, 2001; Duval, 2002].

As a result of the experience gathered from previous analysis on existing LO repositories (such as MERLOT, EdNA, CAREO, WISCONSIN or SMETE) we recognize that the number and the quality of LOs are key issues for the LORs popularity [Silva, 2006]. These issues can be discussed around the following research questions: How can we keep people interested and motivated in producing LOs in number and quality? How do we promote collaboration between users? How can we

reward users that create LOs or that cooperate for the LO repositories popularity? How can we get value from those that retrieve and use LOs?

With these issues and questions in mind, we propose a system that addresses some of the classical difficulties and promotes users to produce and consume LOs in cooperation, involving them in most of the LO repositories functionality, rather than being mere consumers, by just downloading LOs and leaving the repository. In this paper we describe the LOP (Learning Objects Pool) system, proposing a novel approach to cope with the issues mentioned above.

This paper provides a comprehensive overview of the LOP system and, in particular, describes some application scenarios where, through configuration and parameterization we show the LOP's high levels of versatility. Section 2 overviews the LOP system, as well as its main workflows and functionality. Section 3 details some aspects on using LOP, namely LOs submission and LOs purchase. Section 4 introduces the mechanism for setting up the system and discusses its ability to adapt LOP to different application scenarios, with three different scenarios being discussed. A comparison with other related initiatives is discussed in Section 5. Finally, Section 6 presents the conclusions and refers the ongoing work.

2 The LOP System

LOP is a configurable LOs repository with specific features. It aims to maximize authors and end-users participation, without the need to spend large amount of money paying teams to produce LOs. Like all repositories, LOP is a Web based application where users submit and retrieve LOs and the respective metadata. LOP metadata application profile is based on the Dublin Core metadata [Dublin Core, 2006]. It provides search features where users can search inside LOP to get a list of LOs matching the search criteria defined with some metadata values description, category or authors information. The main idea of the LOP system is built around the "stock exchange" metaphor [Samuelson, 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, which causes the total LOP value to change as well, as suggested in Figure 2 and part 8 of Figure 6.

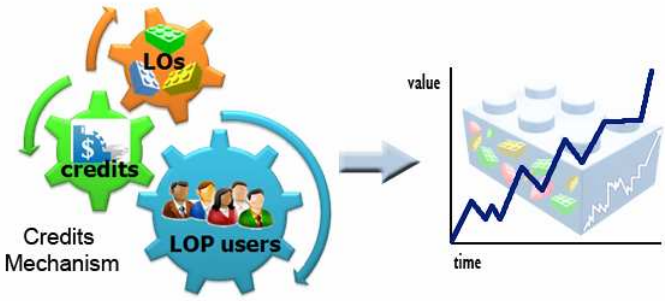

Figure 2: LOP credit-base mechanism

Users gain credits when they submit LO, evaluate or add valuable information to existing LOs, or when they participate in some other LOP functionality such as reviewing LOs. This amount of gained credits allows users to retrieve other LOs, and also provides a way to evaluate the users' level of cooperation. The interest of a LO repository that follows the proposed credit-based approach is an innovative way to promote users collaboration, as well as to 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 LO repository, like the proposed LOP system, can be implemented in different contexts such as schools, universities, enterprises, and communities of practices, because, we believe, it encourage motivation, cooperation and collaboration among a large number of involved stakeholders.

The interactions between users and LO causes users and LOs values to change. The value of a LO depends on the number of purchases which are performed over time. Hypothetically, when the user registers itself in LOP, he can receive automatically an amount of credits, needed to buy LOs (a king of "welcome bonus") . The amount of credits spent with the LO purchase can be recovered when the user associates relevant information to the LO, such as assigning a rating, making a comment or share learning experiences for that LO. We underline the fact that all this information, associated with the LO, constitute an added value and a key factor for other users that wish to acquire that LO.

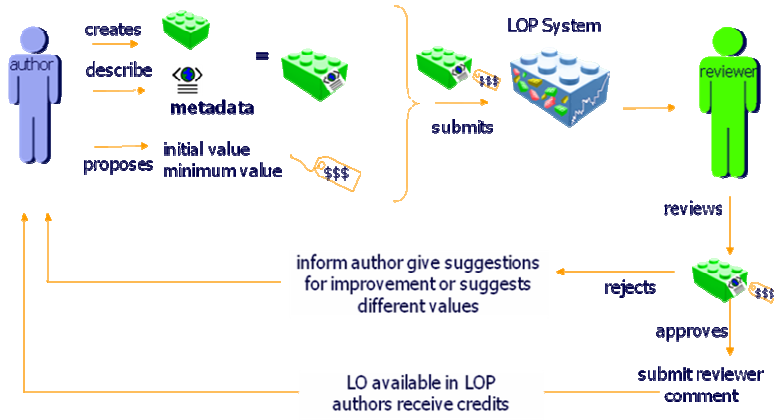

Figure 3: LO Submission Workflow

Figure 3 suggests the LO submission workflow where author submits the LO, associates its metadata and assigns an initial and minimum value for the LO. If the LO is accepted, the reviewer submits his comment and rate the LO (for example, in a 1-5 scale). The LO is thus available on the LOP along with the reviewer's revision and rating, which can be viewed as the first relevant opinion on LO's quality. If the reviewer rejects the LO he should inform the author of the reasons for his decision, giving suggestions for improvement or reassessment of the values proposed. As the value of the LO varies with the number of purchases, the initial value is the value that

the LO takes on the day of its publication. The minimum value represents the lower limit by which the LO can be acquired, since the lack of LO purchases leads to a decline in their value. Once reached the minimum value, it remains unchanged until purchases are made, leading to increase its value again, and so on and so forth.

As suggested in Figure 4, users can perform simple or advanced searches. After the search, a list of LOs that meet the criteria is presented. Users can view most of LOs information, such as metadata, the reviewers comment, rate, and other information submitted by users. However, if the user wishes to acquire the LO, he needs to have the corresponding LO value in credits. As referred before, after the LO purchase, user may submit relevant information, including using suggestions or reporting the learning experiences. By submitting this type of information, the LO is enriched and the user can recover part of the credits spent on the LO purchase.

Figure 4: LO Purchase Workflow

3 Using LOP – Relevant Aspects

The LOP system is a collaborative Web-based application that supports user communities as part of the teaching and learning processes. Technically the LOP system has been implemented through a modular, iterative and incremental approach [Silva, 2007]. LOP features have been implemented according to a set of integrated independent modules on the top of WebComfort platform.

WebComfort is a Web Content and Application management framework, promoted by SIQuant [SIQUANT, --] and implemented using Microsoft's ASP.NET 2.0 technology, that allows, in a dynamic and integrated fashion, the management and operation of web applications [Saraiva, 2008]. WebComfort provides mechanisms for content management (structured or not) through generic Web clients (e.g., Internet Explorer, Mozilla Firefox). It also allows access from mobile devices (e.g., mobile phone or PDA), albeit in a more limited fashion. The WebComfort provides various technical features, including [Carmo, 2006]: (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) web parts technology integration; (6) multi-language support; (7) support and management of visual themes; (8) toolkit manager and (9) workflow manager.

Figure 5 shows the main user profiles (or roles) considered for the LOP system, namely Anonymous User, Registered User, Group Manager, Reviewer, Manager and Administrator.

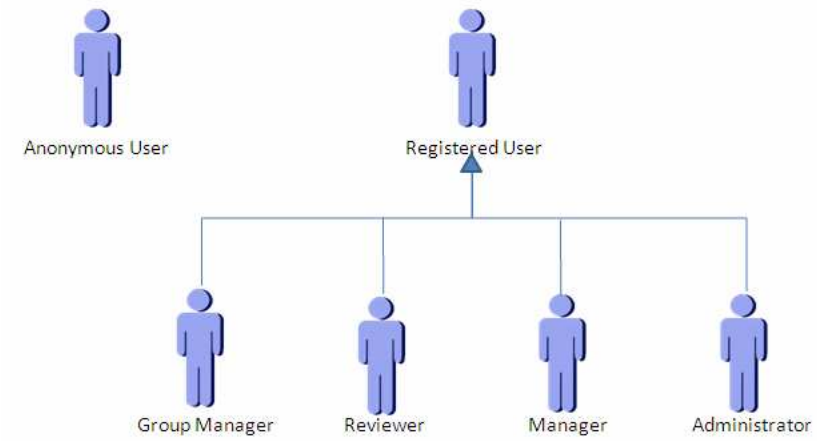

Figure 5: Users Profiles (or Roles)

Figure 6 illustrates the homepage of the registered user after login. There are some relevant aspects to be considered on this page, namely:

(1) Available pages (it depends on the user profile);
(2) User credits information;
(3) LO submission, collections and user information;
(4) Simple or advanced search;
(5) General information about LOP such as welcome message, events and announcements;
(6) List of last LOs submitted;
(7) LO rankings, e.g. rankings with the most purchased LO;
(8) Global LOP value temporal evolution.

Any registered user can submit LOs by filling a considerable set of metadata (according to Dublin Core standard) and uploading the LO itself, as illustrated in Figure 7. There is a minimum set of mandatory and relevant information presented in the submission page. Other information, such as authorship or relationships, is optional and can be activated and submitted using the respective buttons located on the bottom of the form. Figure 7 also suggests the LOs authors association by filling its authorship percentage. This information is relevant to claim the percentage of

credits won by submission or in future LOs shopping. Following the LO submission, it may go through a workflow for review, which awaits the acceptance by the reviewers, or be accepted immediately. In all these cases the credits are assigned to its authors, according to a weighting based on its authorship percentage.

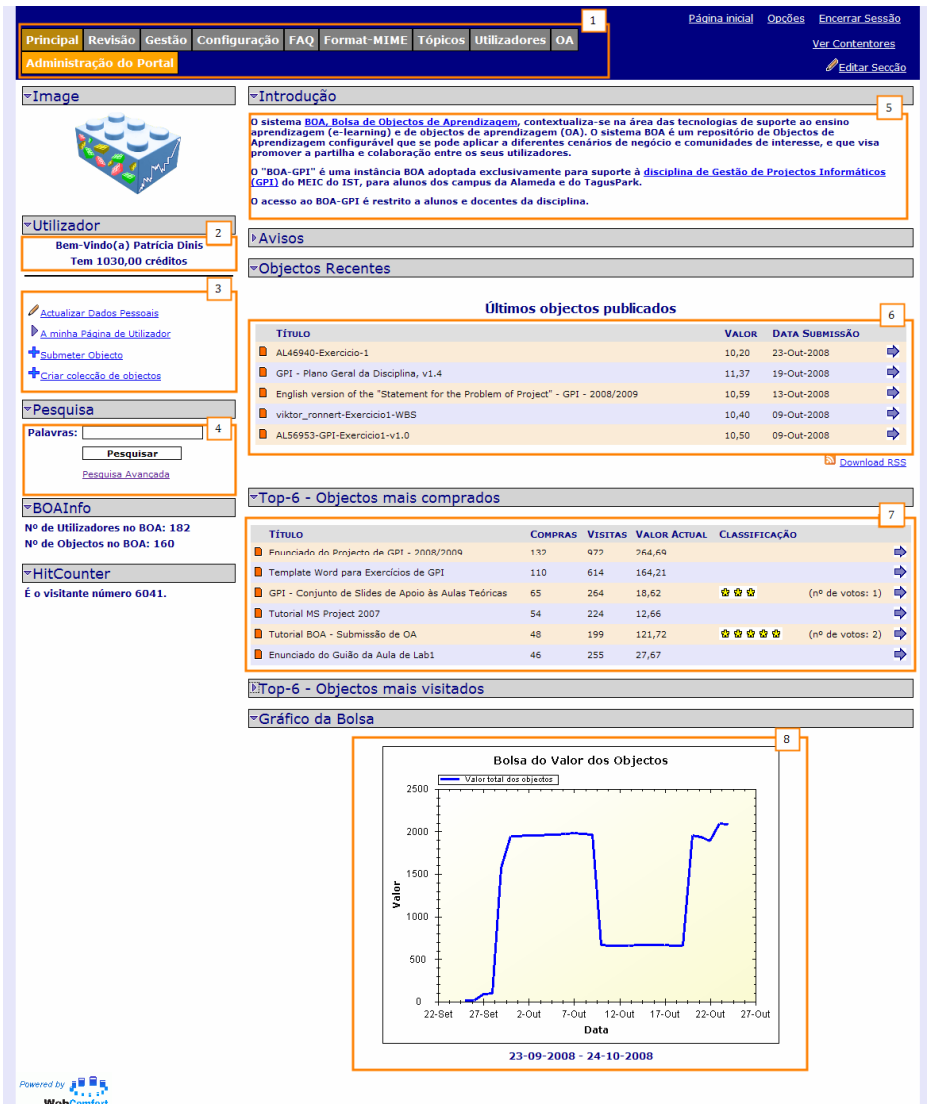

Figure 6: Registered user home page

Users can access the LO using the LO links available on the homepage (e.g., from the "top-6 Most bought LOs" ranking) or via search features. The system provides an

option to perform searches by keyword or some other metadata fields such as language, type of LO, or topic, among others.

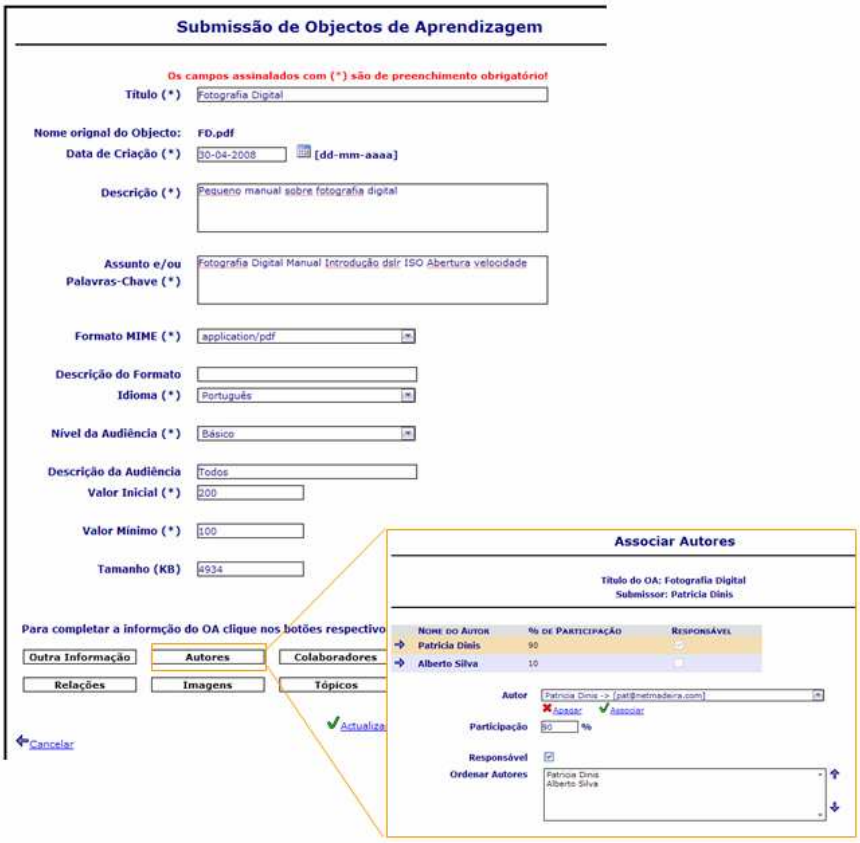

Figure 7: LO page submission

Following any of these situations, the user access the LO's individual page (see Figure 8) where it is possible to get: (1) LO's general information; (2) Information about its author and authorship percentage; (3) Relations with other LOs; (4) LOs comments, rates, and learning experiences; (5) Actual LO value, number of purchases, and LO rating and (6) LO value temporal evolution.

After consult all these information, the user can buy the LO itself or (if already did it) download the LO several times.

This page also allows users who acquired it to associate the relevant information mentioned before, in order to recover some of the credits spent.

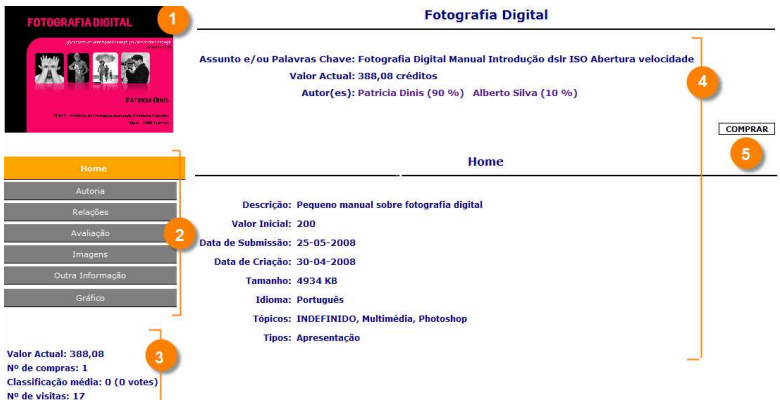

Figure 8: LO page

4 LOP Application Scenarios

The LOP system was designed and implemented to be applied in different situations and scenarios of application. This objective was achieved by the fact that provide some configuration parameters to be changed, such as whether there is reviewing workflow, the increase and decrease rate of LOs values, and the value attributed to each author, among other possible variability's can be defined by the LOP administrator. These parameters can be adjusted over time to better suit the system to possible changes in business rules or other management factors.

In this section, we discuss three scenarios. The scenario-A University Course, based on the higher education context, in which the value of credits earned by students can be used to calculate (in some percentage), the final grade of their course. The scenario-B is related with open communities without reviewing workflow. Finally scenario-C is in a commercial context, in which authors can see what their work rewarded directly in cash, according to the authorship rights required by law.

4.1 LOP Configuration Mechanism

The versatility and flexibility of the LOP system arise primarily from the combination of two distinctive aspects: the flexible user credits mechanism and the LO related functionalities and, moreover, the mechanism for the extensive configuration and parameterization of the system, illustrated in Figures 9 and 10. Based on the table in Figure 9 LOP administrator can configure the system to adapt to different requirements. For instance, it is possible to set the amount of credits that each author receives after the LO submission, and also to set if that value is determined by a percentage of the LO value or whether it is a fixed amount, equal for all LOs. It is also possible to define the values of credits to reward the cooperation of users, and the percentage that causes LOs value to increase or decrease depending on its purchases.

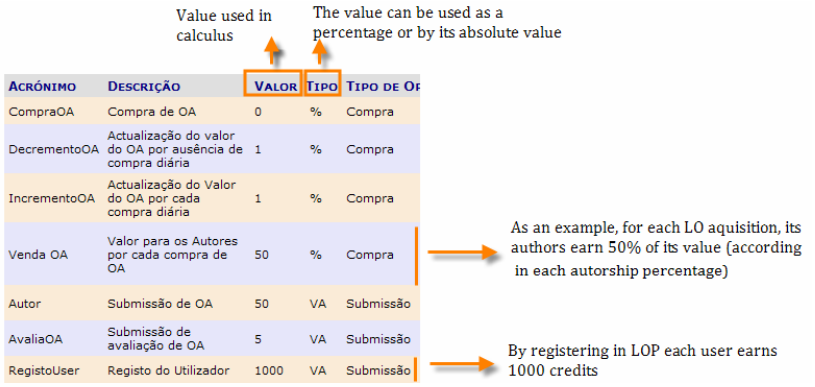

Figure 9: LOP Configuration table (partial view)

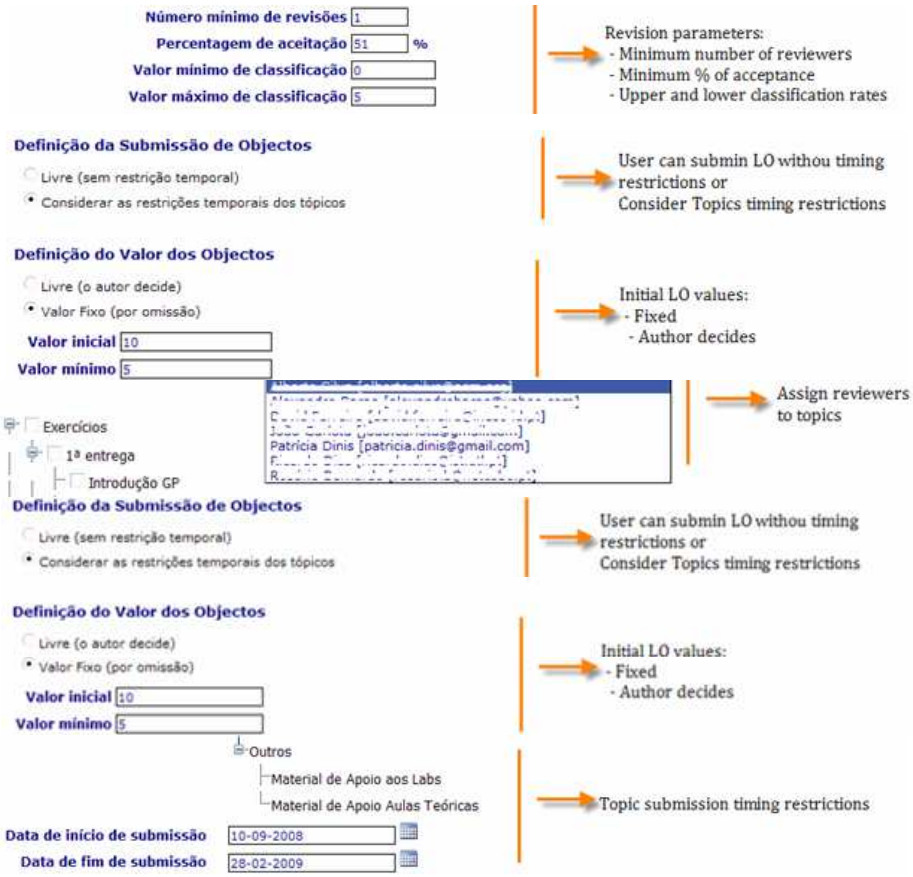

Figure 10: Other Configuration Options

4.2 Scenario A – University Course

Consider the scenario in which faculties in higher education use the LOP system as a tool to support their teaching resources and students assignments. Faculties can share and make available online material, and the system can calculate students' collaboration on possible tasks and challenges defined by teachers. The rules and criteria for assigning scores should be defined in advance by the group of teachers of specific courses. These scores should then be used to calculate the students' final score together with other assessments like exams or projects. In this scenario, the lecturers play the reviewer role with responsibility for LOs reviewing and evaluation. These LOs can be bought by classmates, without spending any credits (0% * LO value), and so can be rated according to the classification assigned by the faculties and classmates. The value assigned for LO submission and other information is summarized in Figure 11, which illustrates the main rules for this scenario.

As students submit LOs, the teacher can propose new mandatory tasks, for example the comments submission on certain LOs, allowing registering progressive work throughout the semester and taking advantage of the LOs created by the students themselves. The LO submission can embrace both individual and team work (by associating students and their percentage of authorship for each LO). The continuous use of LOP all over the years, collecting and sharing LOs, promoting creativity, competitiveness and healthy critical sense among students would provide a large and suitable repository. Of course this scenario can be also applied to K-12 level of education. However, it is recognized that at this education level students are more immature and dependent, so the success of this approach is questioned. Still, this scenario can be applied with the advantages mentioned above, in e-Learning or blended learning courses.

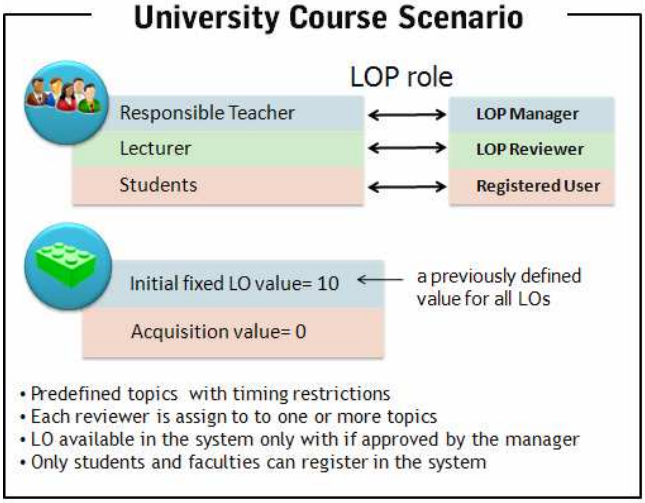

Figure 11: Scenario A – University Course

4.3 Scenario B - Open Community

The scenario B considers the situations where all people can participate in an open community by submitting or downloading LOs available on the system. This kind of participation can be sponsored by publicity since usually comprises lots of users. In this scenario the reviewer workflow can be omitted, making available all submitted LOs and so compromising LOs quality. However, by submitting high quality and sought LOs, authors increase the chance of selling them, being reward with credits for each selling operation. Also, user and LOs rankings will be available, which causes better visibility for the users with more credits and higher levels of collaborations. An important aspect is LO classification or categorization. This should be supported according a large but comprehensive hierarchy of topics such as those find in Yahoo. Other aspect is related with LOP capacity to support multi-language, where users can choose which language fits them better. Users can also chose one of the copyright terms of Creative Commons by changing from "All Rights Reserved" to "Some Rights Reserved" [Creative Commons, --].

Figure 12 illustrates the main rules for this scenario, where the value for LO purchase is the LO value itself, and authors can be rewarded with a previously defined percentage of its current value (e.g. 80%). When user registers in the system she receives a previously defined amount of credits (the welcome bonus, e.g. 500 credits), allowing her to immediately buy some LOs and to interact with the system features.

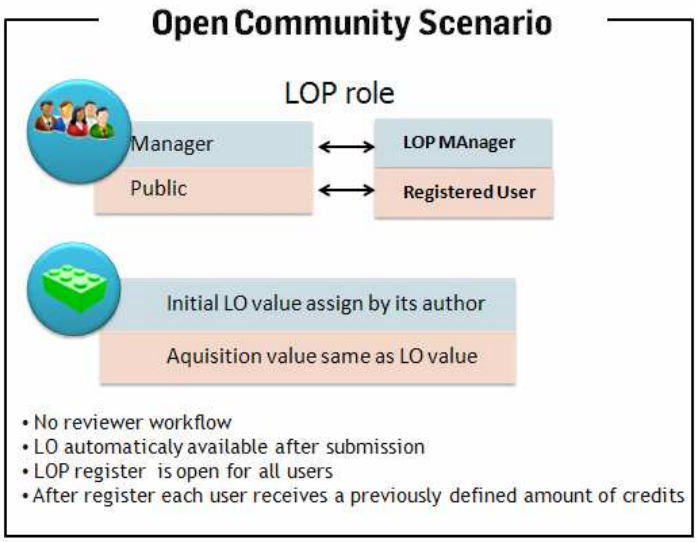

Figure 12: Scenario B – Open Community

4.4 Scenario C – Academic Publisher

Nowadays, academic publishers have web sites where they provide educational content. Usually, users must buy these contents which are produced directly by the publisher. In this scenario, publishers can use LOP system, sell their own LOs, but

also sell LOs produced by other authors. The publisher would have the responsibility to administer, manage and promote the system and set up the number of reviewers. The LO submitted would be available for sale after the evaluation and approval by the reviewers, as a quality assurance. Authors propose the initial LO value, but this value can be discussed and agreed with the reviewers. The LO value would not be changed in accordance to popularity, since it represents the actual value of purchase. In general, any user can submit LOs. For example, a teacher who has created a LO to be used in their classes could submit it in the system for sale. However, the process of LO assessment is essential for the credibility of the system.

The following lists some of the business rules and interactions relating to this scenario: after registration users, can receive a previously defined amount of credits that can be used for discount on the first LO purchases; users gain credits when they submit LO, or when contribute for other LOs, such as commentaries, the educational experiences or suggestions for improvement and classifications. These credits can be accumulated and be exchanged for discount coupons which, in turn, can be used for the purchase of other LOs; each credit can value, for example, a discount of € 0.10. Periodically (e.g. quarterly) the authors receive the respective cash value amount corresponding to the credits gain of their LO's purchase.

Figure 13 illustrates the summary of the relevant rules.

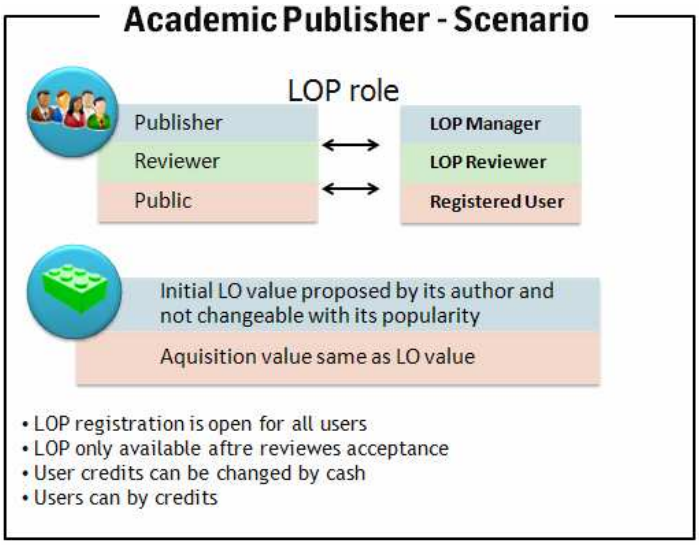

Figure 13: Scenario C – Academic Publisher

The sale of LOs should naturally be regulated by the existing legislation, namely regarding Intellectual Property and Copyright Laws. Finally, a key issue involving this scenario is the LOs price their quality and, in particular, their price/quality relation as should be understandable by the market, i.e. by the end-users.

5 Discussion

Learning Objects Repositories are becoming important resources as the quality and quantity of LO increases. In an initial work we researched and analysed existing LORs [Silva, 2006]. In particular, we analyzed 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. More information on this analysis can be obtained from the referred paper.

A recent research on LORs still addresses the existing types of LORs and its principal features [McGreal, 2007]. In this research McGreal analyses which features are more or less universal, and which are specific to certain types of LORs and also, if with the vast amount of information available on the Internet, is there a need for LORs. He concludes that: (1) there are three main types of LORs: Type 1, that stores LOs and metadata on the site; Type 2, that provides metadata and links to LOs hosted in other sites; and Type 3, that provides both contents and links. According to this classification, LOP is clearly a Type 1 LOR. The granularity of the objects ranges from a single image to full courses. LOP supports different granularities from a simple LO to collections of existing LOs in order to make a complete course. The majority of the LORs are open to the public but some of them require a subscription or membership or even a payment to view or use their materials. In this matter LOP is innovative and flexible, making possible to configure each LOP instance be open for the public or even with some access restrictions depending on the submission topic or group of users.

Most of LORs uses a simple metadata profile while few of them use IEEE LOM, IMS or Dublin Core. The levels also vary from K12, University and All levels. Some are target to specific subjects but most of them are generalist. LOP's metadata is ab extension of Dublin Core, and LOP's instance can be applied at different levels of knowledge areas and situations, as discussed in this paper.

According to Higgs, LORs need to provide management and administrative functions like [Higgs, 2002]: (1) search/find; (2) quality control; (3) request; (4) maintain; (5) retrieve; (6) submit; (7) store; (8) gather and (9) publish. LOP provides all these functions except gathering. LOP supports two different types of search and can ensure LO quality by the peer review process and rates from the other users.

Finally, however, it is important to emphasize the versatility and the flexibility of the scenarios just discussed. The situations and even the values (of credits, percentages and so on) were of course presented only for discussion purposes and should be naturally adjusted in concrete application scenarios. An essential aspect of LOP implementation is how to use and translate the concept of "credit" the central concept of the whole system. For our research it was found that the credits can be translated easily and objectively into different situations, such as the students' performance (Scenario A) or the popularity and quality of authors (Scenario B and C). Credits can also be converted directly into cash (as a form of business for the

publisher and authors, as discussed in Scenario C) or into students assessment (Scenario A), or even into "neutral credits" without any target translation (as discussed in Scenario B).

The LOP versatility and flexibility for supporting different scenarios arise primarily from the combination of its distinctive technical aspects. First, the existence of a flexible credit-based system. Second, the mechanism existence for setting an extensive parameterization of the system as it is depictured in Figure 9 and 10. Third, the fact that LOP system has been developed on the top of the WebComfort platform (a modular and versatile CMS) gives it an additional level for customization, and easily integration with other contents and features.

6 Conclusion

LOP system is a LO repository that promotes the active collaboration of its users, both in submission of LOs, as well as in the submission of relevant information that will contribute significantly to its understanding and enrichment. It also allows more efficient LOs use, such as the comments submission, discuss learning experiences, best practices for use and even suggestions for improvement. This promotion is a manner of distinguish and reward users who contribute most in the creation of quality LOs. In addition, LOP also compensates the end-users active and regular collaboration, since their involvement is determinant to the success of this type of system. This form of "distinction and rewarding" is achieved through a credit-based system that calculates the level of users' cooperation. This mechanism can also update the LO value according to its popularity, similar to the stock exchange metaphor, where the LO value raise or fall depends on the number of acquisitions which represents the LO popularity. This variation in LO value can be represented by various types of rankings (e.g. most value LOs, most popular LOs, collaborative authors, most collaborative users) promoting, as intended, a very active, dynamic and collaborative environment.

The LOP system provides currently a good stability in terms of usability and functionality, and has been instantiated in the "BOA4OpenCommunity" to the general public for of demonstration and evaluation purposes [BOA, --].

The LOP system is also being used in concrete learning scenarios, in particular in the group of computer science teachers at a K-12 level school in Funchal, in the context of a university course of the Technical University of Lisbon [BOA-GPI, 2009]. Finally LOP is also being used by other research groups within the SOLITE [Solite, --], a Latin-American collaboration network.

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