

Characterizing the Reuse of Learning Objects in a Specialized Repository

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ABSTRACT

Repositories of digital resources for education, in particular those that contain Learning Objects have been considered as important promoters of the reuse of such documents. The variety available tools that provide for publishing, searching and retrieving objects facilitate and encourage many of the management activities of Learning Objects. An analysis of the activities performed by users in a repository allow us to identify relationships and factors affecting the recycling of a learning resource, which can be useful in developing new management tools or improving existing ones. This paper presents the results of reviewing activities involved in the exchange of digital resources for education by the users of AGORA platform, a Learning Object Management System.

General Terms

learning object, metadata, management, reuse, repository.

Keywords

LO, LOR, IEEE-LOM, SCORM, PQM.

1. INTRODUCTION

The e-Learning promotes the exchange of experiences and knowledge that facilitate the learning of students without the time and space restrictions imposed by traditional models [1]. This purpose is extensible to the means used to disseminate this knowledge.

Development and access to digital resources for education, especially the Learning Objects, is a constant challenge for teachers who use virtual environments to carry out their teaching activities. In this sense the reuse of learning resources is an activity inherent in all processes related to the management of e-Learning, and it ensures a reduction of costs and efforts to develop new products [2].

A Learning Object (LO) is a basic unit of information for educational systems that combines one or more learning resources with metadata that describes them [3]. Its structure allows exchanges among various e-Learning solutions, and their

reuse in different contexts of application without any loss of functionality or features [4]. These learning resources exhibit other features that enhance its use, such as: description, granularity, accessibility, scalability, etc. [5]. This makes them an important option as learning components.

The distribution and reuse of an LO is only possible insofar as it is spread among a community of users that are related to each other or to the context of object use. In this sense, the national digital repositories, such as AGREGA [6] in Spain, play a major role in fulfilling this purpose.

A digital repository makes available a collection of content regardless of its internal structure [7]. It offers a set of tools for storing, indexing and locating stored documents, which favors the collection, access and sharing of their content. This study focuses on Learning Object Repositories (LOR) [8], management systems specialised in registration, search and retrieval of objects.

LOR users employ this space to publish their objects and download the objects published by other users. These interactions encourage the exchange, evaluation and reuse of Learning Objects.

By keeping track of these actions, repositories become a very important source of information with respect to the characteristics and relationships of individuals and the documents used. This information is useful to identify user profiles [9], define rules that can be used to generate metadata [10] or recommend Learning Objects [11].

This work belongs to the line of descriptive analysis about digital repositories, but unlike other studies that analyze the characteristics of stored resources [12] or their growth inside the repository [13], examines the users' activity of a management repository for Learning Objects, especially those actions related to resource sharing.

The paper is organized into 4 sections, including this introduction. Section 2 presents the characteristics of the repository of AGORA platform, highlighting especially those

features that are relevant to the study. Section 3 provides a description of the realised study beginning from the user activities, indicating the obtained results and associated discussions. Finally, the conclusions are presented in Section 4.

2. THE AGORA PLATFORM

AGORA Project [14] aims to design and implement an infrastructure conformed of a collection of services, that will support teachers in their management activities of Learning Objects. AGORA platform is the result of a working collaboration between researchers from universities of Mexico, Spain and Chile.

Since late 2008, there has been a public version available for use in the University of Castilla-La Mancha (<http://smile.esi.uclm.es/agora>), which constitutes the main instance of the project and is the subject of study of this work.

There are also other implemented instances in universities of several countries (Autonomous University of Yucatan, Mexico; Centroamerican University, "José Simeón Cañas", Salvador; Litoral Politecnica Superior School, Ecuador; Republic University, Uruguay) which will form a distributed repositories network, enabling the sharing and reuse of published objects by each of the members of the federated network.

The LO management involves a set of activities and processes required to control their life cycle and quality so that they can be reused [15]. In AGORA, this management is done through a Web client that offers a collection of tools that facilitates access to various services provided for such management: storing, cataloging, retrieval and evaluation (Figure 1). There are also tools designed for course management, metadata, users, forums and the repository itself. All this makes AGORA a quite useful example to characterise the relationships and behaviours that arise between users of a repository.

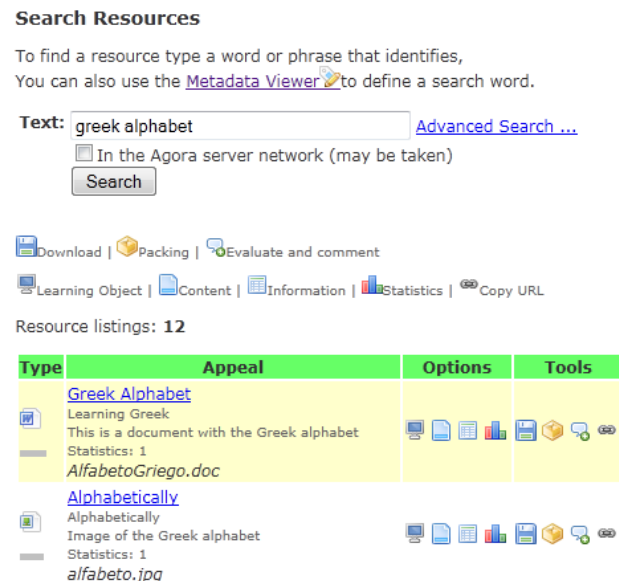


Fig 1: Searching resources in AGORA

The repository of AGORA allows storing metadata and the files of learning resources using a metadata editor and a generation assistant of Learning Objects. For those resources published on

the internet it is possible to import the files directly into the repository or to keep only its external reference, this case being especially useful for reference materials that are conformed by multiple files or have restrictions of use.

The resources stored in the repository of AGORA are catalogued using the IEEE-LOM standard [16] and published for download in the original format, as a Learning Object in SCORM 2004 format [5] or through a link to incorporate directly into a learning management system like Moodle (<http://www.moodle.org>). Users can evaluate and comment on published articles using an instrument based on a particular quality model from a pedagogical perspective called PQM (Pedagogical Quality Measurement) [17].

2.1 The Activity log

AGORA keeps a record of all actions performed by users, including those related to the publication and retrieval of LO in the repository. This log stores the data related to the user and the executed action, which allow the answering of questions like Who? What? How? When? Where?

In addition to the user ID and its location (IP address), the module and the requested action are stored, the parameters sent and the date-time of execution.

Table 1 presents an extract of the activities taken by user 272 over a period of 3 minutes: a conversation with another user (action 1), a search of resources related to the Greek alphabet (action 2), the display of resource 357 (action 3), and finally the downloading and evaluation of it (actions 4 and 5). From this information it is possible to reconstruct the behaviour of a user within the platform and identify patterns of action.

Table 1. Extract of an AGORA user's activity used in the study

#	ID	Module	Action	Parameter	Date
1	272	user	message	action = sent	07/12/2009 8:12:52
2	272	resource	list	q = greek + alphabet	07/12/2009 8:13:05
3	272	resource	view	id = 357	07/12/2009 8:13:24
4	272	resource	download	id = 357	07/12/2009 8:14:53
5	272	resource	valuate	id = 357	07/12/2009 8:14:58

3. ANALYSIS OF REUSE IN AGORA

There are a little more than 65 actions that can be executed in AGORA through 12 modules/tools which control the management within the platform. A selection has been made of those actions related to the reuse of resources, specifically search, view and download of Learning Objects. Table 2 lists the actions used for the study, all of them belonging to the resource module.

From these data are presented the results of a study that describes the characteristics of users and resources associated with these actions, so as to contrast the behavioural pattern of the user groups identified against groups of objects used. Until March 2011 there were 462 users and 513 published articles in AGORA. These elements were considered for the study.

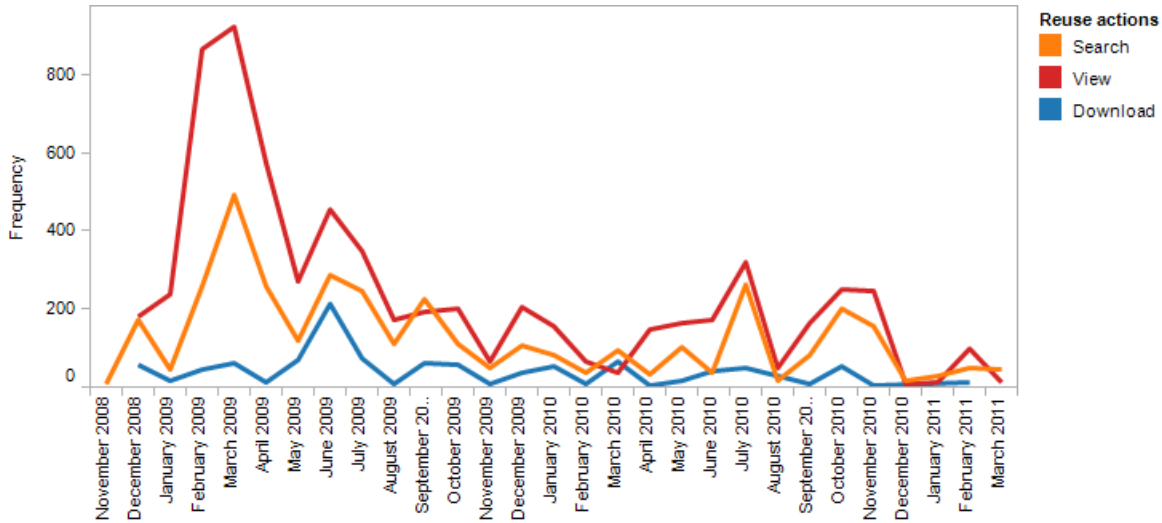


Fig 2: Registration of 3 activities related to the reuse of resources in AGORA

Figure 2 shows the frequency of actions associated with the search, selection and download of the resources published in AGORA from November 2008 to date. It observes that users were not accustomed to the characteristics of the system, which impacts in its initial use; then, as a result of a process of familiarisation with the system, they feel motivated to publish or produce LOs, resulting in a considerable increase in the amount of published resources (initial peak), which then stabilises as time goes on.

Table 2. Actions used for the analysis of Reuse in AGORA

Action	Description
Publish	Release a Learning Object to be used
List	Show the searching result
View	Display a Learning Object content
Statistic	Display quality evaluation results of a Learning Object
Download	Download Learning Object's content
Package	Download a Learning Object
Comment	Evaluate the Learning Object's quality

In general a large initial peak can be observed which stabilises as time goes on (see figure 3). Variations can be observed during regular activities, some being quite significant (see the peak that occurred in March 2009). These peaks coincide with the promotion activities of the project that have been made in recent years, for example the activities peak of July 2010 is the result

of a presentation of disclosure given in a International Conference of that year. It is inferred that other changes experienced are the result of periods of summer and winter holidays.

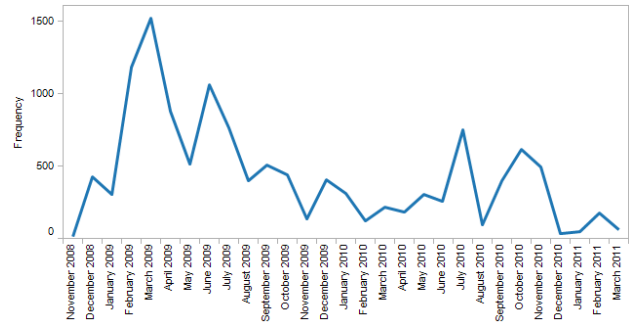


Fig 3: Summary activities related to the reuse of resources

Despite these variations, a detailed analysis of reuse indicates that in an average month 17 Learning Objects are published, 126 resource searches are run, from which the results are analysed, 224 articles that can be useful and finally 25 them are downloaded and 4 are evaluated. It is important to note that many browsers are not able to deploy an LO, instead it is stored in the user's computer, so the visualization also involves a download.

An analysis by scientific-technical disciplines of management

Table 3. Registration activities associated with reuse by area of knowledge

Knowledge area	Users	Upload	Search	View	Download	Evaluate
Agricultural Sciences	3	4	7	0	0	0
Health Sciences	7	13	8	62	2	0
Natural Sciences	26	9	118	138	7	39
Social Sciences	26	51	87	179	56	0
Education and Humanities	71	57	352	565	56	10
Engineering and Technology	103	142	636	1385	196	22
Total	236	276	1208	2329	317	71

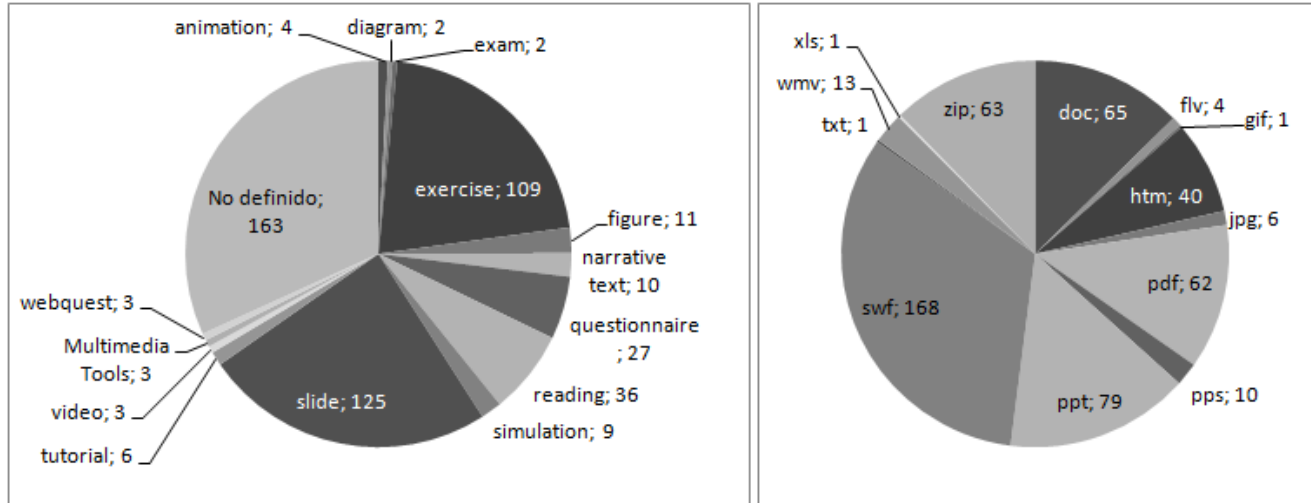


Fig 4: Distribution of AGORA Learning Objects by type and format

activities done in the repository reflect that there exists a greater participation of teachers of Engineering and Technology, and Education, Humanities and Artistic Works in the actions of reception, such as search and display (or passive), which are specified in specific downloads; in contrast to the actions of production, such as publication and evaluation. Therefore it is necessary to encourage these latter actions.

It reveals in detail that technologists obtain the most advantage of published resources; in second place are the teachers of education and social areas. Other interesting facts are revealed in Table 3, for example, teachers of the Natural Science are more critical of the content published (39 evaluations). It is important to note that only 51% of the AGORA users was considered, because it is they who indicated their area of expertise.

With respect to the resources stored in AGORA, the majority of the 513 LO have Spanish language content (76%), but also there are English and French contents. Figure 4 shows the distribution by types of objects according to the IEEE-LOM, as well as by file format. Most Learning Objects are slides (24%) and exercises (21%). Among the most common file types included are Flash animations (33%), PowerPoint presentations (17%) and PDF (12%) and Word documents (13%).

Table 4 presents the detail of downloaded resources by teachers from two areas of knowledge in the past 6 months. While Education area professionals have a preference for presentations (13 ppt), technologists prefer the animations (39 swf). Multimedia documents are the common denominator for both areas.

4. CONCLUSIONS AND FUTURE WORK

The Learning Object Repositories are spaces where teachers interact to publish and share resources which support their

teaching. By characterising the management of the Learning Objects, these spaces become an important source of qualitative and quantitative information about the carried out actions, which is important for the development of new tools or to incorporate functionalities that facilitate the reuse of stored resources.

In this paper we have presented the evolution of management activities associated with the reuse of Learning Objects that exist in a repository. The various tools provided by AGORA make it a very useful example to characterise such reuse.

The repository starts with a large user activity, in terms of publishing and retrieval of objects, which stabilises as time goes on. There are variations in the regularity of activities, some of them being pretty significant and coincident with the promotional activities of the project.

These results are consistent with those reported by Ochoa et al. [13], in the sense that repositories have a strong social component that should be considered to ensure proper promotion and reuse of resources.

As future work presents the challenge of encouraging teachers of the participating institutions to publish resources and encourage the exchange of knowledge and experience in the development of Learning Objects. AGORA is intended to constitute a basic framework for the development of new services, as well as to study the impact of the new technologies in improving the academic and administrative processes with support from an efficient use of existing resources.

A projection for the future of this work revolves around the development of a linguistic summaries generator that transforms the statistical values in natural language descriptions. These reports facilitate decision-making regarding the management of the various elements of the repository, because they present the

Table 4. Extract from the reuse of Learning Objects to users of two areas of knowledge during a period of 6 months

Knowledge area	Users	doc	flv	htm	jpg	pdf	ppt	swf	wmv	zip
Education and Humanities	16	5	1	4	0	3	13	11	8	7
Engineering and Technology	25	10	3	14	3	11	16	39	3	7
Total	41	15	4	28	3	14	29	50	11	14

information in a more "human" way.

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6. REFERENCES

- [1] Chen, Shen, Wang and Chen. 2007. Collaborative Education Model and Its Application in E-learning. The 6th IEEE/ACIS International Conference on Computer and Information Science (ICIS 2007), 856-860.
- [2] Mohan, P. 2004. Reusable Online Learning Resources: Problems, Solutions and Opportunities. Fourth IEEE International Conference on Advanced Learning Technologies (ICALT'04), 904-905.
- [3] Segura, A., Menéndez, V. and Prieto, M.E.. 2008. Búsqueda y composición de objetos de aprendizaje. X Simposio Internacional de Informática Educativa SIIIE (Salamanca, España, 2008), 335-340.
- [4] Wiley, D. 2002. Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor, and a Taxonomy. Wiley, D.A. ed. The Instructional Use of Learning Objects.
- [5] Advanced Distributed Learning ADL. 2004. SCORM: Sharable Course Object Reference Model 2004 3rd Edition Documentation Suite.
- [6] Sarasa, A., Canabal, J.M. and Sacristán, J.C. 2009. Agrega: A distributed repository network of standardised learning objects. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 466-474.
- [7] IMS Global Learning Consortium. 2003. IMS Digital Repositories Interoperability - Core Functions Information Model Version 1.0 Final Specification.
- [8] Looms, T. and Christensen, C. 2002. Emerging and enabling technologies for the design of learning object repositories. Advanced Distributed Learning Initiative.
- [9] Ferreira-Satler, M., Romero, F.P., Menendez, V.H., Zapata, A. and Prieto, M.E.. 2010. A fuzzy ontology approach to represent user profiles in e-learning environments. in Fuzzy Systems (FUZZ) IEEE International Conference on, (Barcelona, Spain, 2010), 161-168.
- [10] Margaritopoulos, M., Margaritopoulos, T., Kotini, I. and Manitsaris, A. Automatic metadata generation by utilising pre-existing metadata of related resources. Int. J. Metadata Semant. Ontologies, vol. 3 (4). 292-304.
- [11] Zapata, A., Ferreira-Satler, M., Menéndez, V.H., Prieto, M.E., Olivas, J.Á. and Vidal, C.L. 2010. Un sistema de recomendaciones basado en técnicas de soft computing para el filtrado de objetos de aprendizaje. III Simposio sobre Lógica Fuzzy y Soft Computing LFSC2010, (Valencia, España, 2010), Grupo Editorial Gaceta, 295-302.
- [12] Cechinel, C., Sánchez-Alonso, S., Sicilia, M.-Á. and Mattos, M.C. 2010. Descriptive Analysis of Learning Object Material Types in MERLOT. Sánchez-Alonso, S. and Athanasiadis, I.N. eds. Metadata and Semantic Research, Springer Berlin Heidelberg, 331-341.
- [13] Ochoa, X. and Duval, E. Quantitative Analysis of Learning Object Repositories. IEEE Trans. Learn. Technol., vol. 2 (3). 226-238.
- [14] Prieto, M.E. and Menéndez, V. 2009. Gestión Integral de Recursos para el Aprendizaje. in Prieto, M.E., Sanchez-Alonso, S., Pech, S. and Ochoa, X.S. eds. Recursos Digitales Para el Aprendizaje, Editorial UADY, Mérida, México, 27-33.
- [15] Catteau, O., Vidal, P. and Broisin, J. 2006. A Generic Representation Allowing for Expression of Learning Object and Metadata Lifecycle. Proceedings of the Sixth IEEE International Conference on Advanced Learning Technologies, IEEE Computer Society, 30-32.
- [16] IEEE-LTSC. 2002. IEEE Standard for Learning Object Metadata. Learning Technology Standards Committee.
- [17] Zapata, A., Menéndez, V., Eguigure, Y. and Prieto, M. 2009. Quality evaluation model for learning objects from pedagogical perspective. A case of study. International Conference of Education, Research and Innovation (ICERI 2009), (Madrid, España, 2009), 2228-2238.