DESIGNING LEARNING OBJECT REPOSITORIES AS SYSTEMS FOR MANAGING EDUCATIONAL COMMUNITIES KNOWLEDGE

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ABSTRACT

Over the past years, a number of international initiatives that recognize the importance of sharing and reusing digital educational resources among educational communities through the use of Learning Object Repositories (LORs) have emerged. Typically, these initiatives focus on collecting digital educational resources that are offered by their creators for open access and potential reuse. Nevertheless, most of the existing LORs are designed more as digital repositories, rather than as systems for organizing and sharing educational communities' explicit knowledge (depicted in digital educational resources constructed by teachers and/or instructional designers) and tacit knowledge (depicted in teachers' and students' experiences and interactions of using digital educational resources available in LORs). Within this context, in this paper we present an approach for designing LORs as systems for facilitating the organization and sharing of different types of educational communities' knowledge.

KEYWORDS

Learning Object Repositories, Educational Communities, Knowledge for educational practice, Knowledge of educational practice, Knowledge Management

1. INTRODUCTION AND PROBLEM DEFINITION

Today it is commonly argued that, digital educational resources generated by teachers and by students, as well as by teacher-to-students and students-to-students interactions during day-to-day educational activities constitute core knowledge assets of educational communities (Chen, et al, 2009; Hsu et al, 2008; Carroll et al, 2005).Within different educational communities (Wenger and McDermott, 2002), digital educational resources are worthy to be organized, managed, shared and reused effectively (Hsu et al, 2008). For this purpose, a number of international initiatives have emerged recently and they have recognized the importance of sharing and reusing digital educational resources among educational communities typically represented in the form of Learning Objects (LOs) (McGreal, 2004; UNESCO, 2002).

Most of the above mentioned initiatives provide systems and services that aim to support the web-based management of LOs. A particular category of those systems is the Learning Object Repositories (LORs), which are developed to facilitate search, retrieval and access to LOs (Geser, 2007). McGreal (2008) has defined LORs as systems that: "enable users to locate, evaluate and manage learning objects through the use of "metadata", namely descriptors or tags that systematically describe many aspects of a given learning object, from its technical to its pedagogical characteristics". Nevertheless, most of the existing LORs are designed as digital repositories of educational resources providing functionalities only for the organization and sharing of educational communities' explicit knowledge (typically depicted in digital educational resources constructed by teachers and/or instructional designers), whereas functionalities for the organization and sharing of educational communities' tacit knowledge (typically depicted in teachers' and students' experiences and interactions using digital educational resources available in LORs) are very limited. However, both aforementioned knowledge types are very important to be managed, shared and reused effectively among educational community members (McLaughlin and Talbert, 2006).

This is actually a major drawback in the design and development of LORs, since there is not a common approach for designing LORs towards addressing the problem of organizing and sharing different types of educational communities' knowledge.

In previous work, reported in (Kallonis and Sampson, 2010) an initial study of existing LORs from the Knowledge Management Systems (KMSs) perspective has been performed and a list of essential LORs' functionalities has been proposed that could address the problem of organizing and sharing educational communities' knowledge. In this paper, we adopt these functionalities and we present an approach for designing LORs towards addressing the current demands of web-facilitated educational communities, as well as the generation, sharing and application of different types of knowledge among educational community members.

2. KNOWLEDGE MANAGEMENT IN WEB-FACILITATED EDUCATIONAL COMMUNITIES OF PRACTICE

Communities of practice have become increasingly influential within several fields since they are identified as an important mechanism through which individual and group knowledge is created and transferred (Cox, 2005). The concept of communities of practice has been proposed by Lave and Wenger (1991), who define a Community of Practice (CoP) as: "a group of people who share an interest, a craft, and/or a profession. It can evolve naturally because of the member's common interest in a particular domain or area, or it can be created specifically with the objective of gaining knowledge related to their area of interest". CoPs that are facilitated by web-technologies are referred to as web-facilitated communities of practice or virtual communities of practice (Hara et al, 2009).

The concept of CoP has also become very popular in the field of education and learning. As a result, educational communities of practice are being developed focusing on generating, sharing and reusing different types of educational knowledge [9]. The different types of educational knowledge, which can be generated and shared within educational communities of practice, can be divided into two types (Cochran-Smith and Lytle, 1999):

- **Knowledge for educational practice:** this is formal knowledge depicted in the LOs that are constructed by teachers and/or instructional designers of an educational community and they can be used to enhance teachers' day-to-day educational practice. This type of knowledge can be considered as explicit, since it can be articulated codified and stored in certain media (Ronald and Kulkarni, 2007; Tiwana, 2003).
- **Knowledge of educational practice:** this type of knowledge is constructed: (a) by teachers based on their experiences about their students' learning and evidence of their progress in relation to given LOs, (b) by students based on their experiences about the use of given LOs provided by their teachers, and (c) by teachers-students interactions with these LOs. This type of knowledge can be considered as tacit, since it needs special effort to be codified and transferred (Tiwana, 2003).

In order to build systems that facilitate the aforementioned knowledge types in the context of web-facilitated educational communities, Charlier et al (2007) and Goel et al. (2009) have identified a set of needs for web-facilitated communities of practice that should be addressed by these systems. For the purpose of our work, we have compiled and adapted them accordingly, so as to be applicable to web-facilitated educational communities of practice and they are presented below as requirements of such systems and in relation with the aforementioned knowledge types:

- **Requirement 1 – Stimulate participation and interaction:** That is, to stimulate the participation of the educational community members and to foster their active involvement in creation and sharing their own LOs towards constructing explicit knowledge for educational practice, as well as in evaluation and tagging of LOs towards constructing tacit knowledge of educational practice.
- **Requirement 2 – Accommodate informal and spontaneous interactions:** That is, to promote and foster communication and interactions that are not intended and planned but happen by chance towards constructing tacit knowledge of educational practice.

- **Requirement 3 – Empower the individual:** That is, to empower the individuals in web-facilitated educational communities, so as to facilitate them in the process of sharing explicit knowledge for educational practice depicted in their own LOs and tacit knowledge of educational practice depicted in their experiences in using available LOs.
- **Requirement 4 – Foster and stabilize community members' relationships:** That is, to facilitate the creation of stable relationships between community members, so as to raise the level of collaboration, communication and contribution within the community by constructing and sharing either explicit knowledge for or tacit knowledge of educational practice.
- **Requirement 5 – Build trust between community members:** That is, to facilitate the creation of trusted relationships between community members, so as the explicit knowledge for and the tacit knowledge of educational practice that is shared to be considered as valid and useful.
- **Requirement 6 – Simplify access to the community:** That is, to provide the appropriate facilities (infrastructure, tools and services) that would simplify access to the community, so as to enable sharing and transferring of explicit knowledge for and tacit knowledge of educational practice.
- **Requirement 7 – Distinguish different levels of participation:** That is, to identify active contributing members of the community and acknowledge them as the core contributing group regarding the explicit knowledge for and the tacit knowledge of educational practice, which are constructed and shared among community members.
- **Requirement 8 – Maintain the sense of being part of the community:** That is, to provide the appropriate facilities (infrastructure, tools and services) that would raise the members' sense of being part of the community towards enabling them to actively participate to the construction and sharing of explicit knowledge for educational practice and tacit knowledge of educational practice.

Additionally, in order to support typical knowledge management processes in the context of web-facilitated communities of practice, Tang et al. (2009) have identified eight (8) specific activities that web-facilitated community members should perform. For the purpose of our work, we have adapted these activities accordingly, so as to be applicable to web-facilitated educational communities of practice and they are presented below in relation with the aforementioned requirements:

- **Activity A – Construct Knowledge:** During this activity the members of the community (either as individuals or as members of a group) create new LOs (that is explicit knowledge for educational practice) and/or they provide their experiences in using available LOs (that is tacit knowledge of educational practice) using the available infrastructure. Both educational knowledge types can then be shared within the community (Activity C – Share Knowledge).
- **Activity B – Synthesize Knowledge:** During this activity the members of the community (either as individuals or as members of a group) use the existing educational knowledge in its explicit form (namely, LOs) and/or in its tacit form (namely, experiences in using available LOs via forum discussions, blog posts, social tagging, personal messages and/or wikis), in order to support Activity A – Construct Knowledge.
- **Activity C – Share Knowledge:** This activity is twofold. The members of the community (either as individuals or as members of a group) (i) share the explicit educational knowledge (LOs) that was constructed during Activity A and/or (ii) share their tacit educational knowledge through web 2.0 tools (namely, blogs, wikis, social tagging and social networks)
- **Activity D – Learn:** During this activity the members of the community (either as individuals or as members of a group) use the knowledge presented in the community by either searching/retrieving it (Activity H – Search/Retrieve Knowledge) or by using Web 2.0 tools (Activity B – Synthesize Knowledge), so as to enhance their learning.
- **Activity E - Evaluate Knowledge:** During this activity the members of the community (either as individuals or as members of a group), perform some type of formal or informal (through simple reflections) evaluations on the educational knowledge which is presented in the web-facilitated educational community. The members may rate and comment on the appropriateness of the LOs presented in the community by using Web 2.0 tools (Activity B – Synthesize Knowledge).
- **Activity F – Distill Knowledge:** During this activity the members of the community (either as individuals or as members of a group), assess the design of explicit educational knowledge (depicted in LOs), in order to identify patterns that may lead to the extraction of general designs for later use and/or reuse.

- **Activity G – Apply Knowledge:** During this activity the members of the community (either as individuals or as members of a group) use the educational knowledge which is available in the community by applying it in their own educational practices. This can lead to the creation of new explicit and/or tacit educational knowledge (Activity A – Construct Knowledge).
- **Activity H – Search/Retrieve Knowledge:** During this activity the members of the community (either as individuals or as members of a group) search and retrieve the existing educational knowledge that is available within the community, in order to support all the above mentioned activities.

3. LEARNING OBJECT REPOSITORIES AS KNOWLEDGE MANAGEMENT SYSTEMS

In previous work, reported in (Kallonis and Sampson, 2010) an initial study of existing LORs from the Knowledge Management Systems (KMSs) perspective has been performed and a list of essential LORs' functionalities has been proposed that could address the problem of organizing and sharing educational communities' knowledge. Table 1 presents an extended list of LORs functionalities from a knowledge management perspective.

Table 1. Extended List of LORs' Functionalities from a Knowledge Management Perspective

LORs Functionalities	Description
LOs Component	
Store	This functionality enables LORs' end users to store in the LOR their LOs and/or links to external LOs, so as to be able to reference them with unique URLs for future use and sharing them with other users.
Search	This functionality enables LORs' end users to search LOs using appropriate commonly agreed terms which are matched with metadata descriptions of the LOs
Browse	This functionality enables LORs' end users to browse LOs according to different classifications based on their metadata descriptions
View	This functionality enables LORs' end users to preview the content of the LOs
Download	This functionality enables LORs' end users to download the LOs and further use them or modify them locally (when the license associated with this LO permits modifications)
Rate/Comment	This functionality enables LORs' end users to provide their ratings and comments for the LOs stored in a LOR.
Bookmark	This functionality enables LORs' end users to bookmark LOs and add them to their personal and/or favorite lists, so as to be able to access them more easily in the future
Automatic Recommendations	This functionality analyzes users' previous actions regarding LOs search and retrieval, and it automatically recommends to them appropriate LOs that are related with the LOs that has been previously searched and retrieved
Knowledge Filter	This functionality is used in order to provide LORs' end users with better rankings of LOs during their searching, which are based on other users' comments and ratings
Mash-ups	Mash-ups refer to web applications which present data acquired from different sources and combined in a way which delivers new functions or insights. This functionality enables LORs' end-users to perform fedearted searches and retrieve LOs from other LORs.
Metadata Component	
Store	This functionality enables LORs' end users to store in the LOR the metadata descriptions of their LOs, so as to be able to reference them with unique URLs for future
View	This functionality enables LORs' end users to view in details the metadata descriptions of LOs, so as to be able to decide whether to use or not a specific LO
Download	This functionality enables LORs' end users to download the metadata descriptions of LOs in XML format conformant with IEEE LOM Standard, so as to further process them with appropriate educational metadata authoring tools and upload them back to the same LOR or to another LOR
Validate	This functionality is used for validating the appropriateness and the quality of the metadata descriptions provided for the LOs by their authors and in many LORs this functionality is available to a limited number of back-end users (namely, metadata experts), who undertake the task to ensure the quality of metadata descriptions
Social Tagging	This functionality enables LORs' end users to characterize LOs by adding tags to them.

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	Other Added-Value Services
Pesonal Accounts	This functionality enables LORs' end users to create and manage their own personal accounts by completing their personal information and preferences. User accounts include also information about: (a) the LOs that a user has contributed to the LOR, (b) the LOs that the user has bookmarked and (c) the ratings/comments and tags that the user has provided to the different LOs of a LOR
Forums	This functionality enables users to communicate and exchange ideas in an asynchronous way about the use of LOs that are stored in a LOR
Wikis	This functionality facilitates users to create wikis and share information about their experiences with the LOs that are stored in a LOR
RSS Feeds	This functionality enables users to be informed via RSS readers about new LOs, which are added to the LOR without visiting the LOR
Blogs	This functionality enables LORs' end-users to build and maintain their own blogs for publishing their opinions about LOs stored in LORs and receiving comments from other end-users about their reflections
Social Networks	This functionality enables LORs' end-users to build online social networks based on the LOs that they are offering to the LORs, so as to share their common interests.

As we can notice from Table 1, there are functionalities related to three (3) different components which constitute a LOR, which are:

- **Learning Objects Component Dimension:** The functionalities related to this LOR component enable LORs' users to interact with either the LOs locally hosted by the LOR or the links to externally hosted LOs, in various ways, such as store, search, browse, view, download, rate/comment, bookmark and automatic LOs recommendations
- **Learning Objects Metadata Descriptions Component Dimension:** The functionalities related to this LOR component enable LORs' users to interact with the metadata descriptions of the LOs, in various ways, such as store, view, download, validate and social tagging.
- **Added-Value Services Component Dimension:** The functionalities related to this LOR component aim to enhance the experience of the LORs' users in relation to the other two dimensions including services such as the creation of personal accounts, forums, wikis and RSS feeds for new LOs added to the LOR.

Next, we consider these functionalities and we present an approach for designing LORs as systems for managing educational communities' knowledge.

4. AN APPROACH FOR DESIGNING LORS AS SYSTEMS FOR MANAGING EDUCATIONAL COMMUNITIES' KNOWLEDGE

Porter (2008) has proposed the Activities, Objects and Features (AOF) method for designing web portals which includes three (3) general steps. For the purpose of our work, we have adapted these steps, so as to be applicable for designing LORs that aims to address the requirements of web-facilitated educational communities and support knowledge management activities of educational communities' members:

- **Step 1 - Focus on the primary Activity:** This step includes the identification of the primary activity that the users perform in a web portal. For the case of LORs the primary activity is the organization and sharing of the different types of educational knowledge (namely, explicit knowledge for educational practice and tacit knowledge of educational practice)
- **Step 2 - Identify the social objects:** This step includes the identification of the objects that users interact with while performing the primary activity defined in step 1. For the case of LORs, the social objects are the LOs that are available to the educational community members of these LORs.
- **Step 3 - Choose the core feature set:** The final step includes the identification of the core feature set that will facilitate the users of the web portal to perform actions on the social objects defined in step 2. For the case of LORs, the core feature set could be based on the extended list of LORs functionalities (as presented in section 3). The specific functionalities for designing a LOR could be selected according to the requirements of web-facilitated educational communities (as presented in section 2) that need to be addressed and the generic knowledge management tasks (as presented in section 2) that need to be performed by educational community members within the designed LOR.

To this end, for each requirement and KM activity identified in section 2, we can identify those functionalities that are needed to meet each of these requirements and KM activities. Table 2 presents the mapping between the extended list of LORs' functionalities and the requirements of web-facilitated educational communities addressed by each functionality, whereas Table 3 presents the mapping between the extended list of LORs' functionalities and the KM Activities that are supported by each functionality.

Table 2. Mapping Extended List of LORs' Functionalities to Requirements of Web-Facilitated Educational Communities

LORs Functionalities	Requirements of Web-Facilitated Educational Communities							
	R1	R2	R3	R4	R5	R6	R7	R8
LOs Component								
Store	✔	-	-	-	-	-	✔	-
Search	-	-	✔	-	-	-	-	-
Browse	-	-	✔	-	-	-	-	-
View	-	-	✔	-	-	-	-	-
Download	-	-	✔	-	-	-	-	-
Rate/Comment	✔	-		-	-	-	✔	-
Bookmark	-	-	✔	-	-	-	-	-
Automatic Recommendations	-	-	✔	-	-	-	-	-
Knowledge Filter	-	-	✔	-	-	-	-	-
Mash-ups	-	-	✔	-	-	-	-	-
Metadata Component								
Store	✔	-	-	-	-	-	✔	-
View	-	-	✔	-	-	-	-	-
Download	-	-	✔	-	-	-	-	-
Validate	✔	-	-	-	-	-	✔	-
Social Tagging	✔	-	-	-	-	-	✔	-
Other Added-Value Services								
Pesonal Accounts	-	-	✔	✔	✔	✔	✔	✔
Forums	✔	✔	-	✔	✔	-	-	✔
Wikis	✔	✔	-	✔	✔	-	-	✔
RSS Feeds	-	-	✔	-	-	✔	-	
Blogs	✔	✔	-	✔	✔	-	-	✔
Social Networks	✔	✔	-	✔	✔	✔	-	✔

Table 3. Mapping Extended List of LORs' Functionalities to Knowledge Management Activities of Web-Facilitated Educational Communities

LORs Functionalities	Knowledge Management Activities of Web-Facilitated Educational Communities							
	A	B	C	D	E	F	G	H
LOs Component								
Store	✔	-	✔	-	-	-	-	-
Search	-	-	-	-	-	-	-	✔
Browse	-	-	-	-	-	-	-	✔
View	-	-	-	✔	-	✔	✔	✔
Download	-	-	-	✔	-	✔	✔	-
Rate/Comment	✔	-	-	-	✔	-	-	-
Bookmark	-	-	-	-	-	-	-	✔
Automatic Recommendations	-	-	-	-	-	-	-	✔
Knowledge Filter	-	-	-	-	-	-	-	✔
Mash-ups	-	✔	-	-	-	-	-	✔
Metadata Component								
Store	✔	-	✔	-	-	-	-	-
View	-	-	-	✔	-	-	✔	-
Download	-	-	-	✔	-	-	✔	-

LORs Functionalities	Knowledge Management Activities of Web-Facilitated Educational Communities							
	A	B	C	D	E	F	G	H
Validate	✔	-	-	-	✔	-	-	-
Social Tagging	✔	✔	✔	-	✔	-	-	-
Other Added-Value Services								
Pesonal Accounts	-	-	-	-	✔	-	-	-
Forums	-	✔	✔	✔	✔	-	✔	-
Wikis	-	✔	✔	✔	✔	-	✔	-
RSS Feeds	-	-	-	-	-	-	-	-
Blogs	-	✔	✔	✔	✔	-	✔	-
Social Networks	-	✔	✔	✔	✔	-	✔	-

As we can notice from Table 2, it appears that all requirements of the web-facilitated educational communities of practice can be addressed by the extended list of LORs' functionalities. Moreover, as we can notice from Table 3, it appears that all KM Activities executed by the members the web-facilitated educational communities of practice can be addressed by the extended list of LORs' functionalities. As a result, designing LORs that follows the proposed approach can support the management of the web-facilitated educational communities' explicit and tacit knowledge.

5. CONCLUSIONS AND FUTURE WORK

In this paper, it was argued that it is important to design LORs that address the problem of organizing and sharing educational communities' explicit knowledge (depicted in digital educational resources constructed by teachers and/or instructional designers) and tacit knowledge (depicted in teachers' and students' experiences and interactions of using digital educational resources available in LORs). For this purpose, we propose an approach for designing LORs that address the requirements of web-facilitated educational communities and support knowledge management activities of educational communities' members.

Future work includes the exploitation of the results of this work for evaluating whether the features of existing LORs are addressing the tasks that need to be performed by educational community members for organizing and sharing the different types of educational communities' knowledge.

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REFERENCES

Chen, I. Y. L. et al, 2009. Examining the Factors Influencing Participants' Knowledge Sharing Behavior in Virtual Learning Communities. *Educational Technology and Society*, Vol. 12, No. 1, pp. 134–148.

Carroll, J. et al, (2005). Frameworks for Sharing Teaching Practices. *Educational Technology and Society*, Vol. 8, No. 3, pp. 162-175.

Hsu, K. C. and Yang, F.-C. O., 2008. Toward an Open and Interoperable e-Learning Portal: OEPortal. *Educational Technology and Society,* Vol. 11, No. 2, pp. 131-148.

Wenger, E. et al, 2002. *Cultivating Communities of Practice.* Harvard Business School Press, Boston.

McGreal, R., 2004. *Online Education Using Learning Objects*. Falmer Press, Washington, D.C..

UNESCO, 2002. *Forum on the Impact of Open Courseware for Higher Education in Developing Countries Final report*. Available at: <http://unesdoc.unesco.org/images/0012/001285/128515e.pdf> [Accessed 25 February 2013]

Geser, G., 2007. Open Educational Practices and Resources: The Olcos Roadmap 2012. *Revista de Universidad y Sociedad de Conomiciento*, Vol. 4, No. 1, pp. 1-9.

McGreal, R., 2008. A typology of learning object repositories. In: H.H. Adelsberger, Kinshuk, J. M. Pawlovski and D. Sampson, eds. *International Handbook on Information Technologies for Education and Training*, pp. 5-18. 2nd Edition, Springer.

McLaughlin, M. W. and Talbert, J., 2006. *Building school-based teacher learning communities: Professional strategies to improve student achievement*. Teachers College Press, New York.

Kallonis, P. and Sampson, D., 2010. Examining Learning Object Repositories from a Knowledge Management perspective. *Proceedings of the 10th IEEE International Conference on Advanced Learning Technologies (ICALT 2010)*. Sousse, Tunisia, pp. 289 - 293

Cox, A., 2005. What are communities of practice? A comparative review of four seminal works. Journal Information Science, Vol. 31, No. 6, pp. 527–540.

Lave, J. and Wenger, E., 1991. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge.

Hara, N., Shachaf, P. and Stoerger, S., 2009. Online communities of practice typology revisited. *Journal of Information Science*, Vol. 35, No. 6, pp. 740-757.

Cochran-Smith, M., and Lytle, S. L., 1999. Relationships of knowledge and practice: Teacher learning in communities. *Review of research in education*, Vol. 24, No. 2, pp. 249-305.

Ronald, D. F. and Kulkarni, U., 2007. Knowledge management capability: defining knowledge assets. *Journal of Knowledge Management,* Vol. 11, No. 6, pp. 94-109.

Tiwana, A., 2003. *The Knowledge Management Toolkit*, Prentice Hall PTR, USA

Charlier B., et al, 2007. *Designing services for CoPs: first results of the PALETTE project*. Proceedings of the TEL-CoPs'07: 2nd International Workshop on Building Technology Enhanced Learning solutions for Communities of Practice. Crete, Greece.

Goel, L., et al., 2009. Virtual Worlds as Platforms for Communities of Practice. In: W.R. King ed., *Knowledge Management and Organizational Learning*, Springer.

Tang, A., et al, 2009. A comparative study of architecture knowledge management tools. *Journal of Systems and Software*, Vol. 83, No. 3, pp. 352-370.

Porter, J., 2008. *Designing for the social web*, New Riders, Berkeley.