Comparison of educational tagging systems - any chances of interplay?

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Abstract. Web-based tagging systems for educational resources allow users to associate free keywords with resources to facilitate their retrieval and reuse. This paper looks at the similarities and differences among three different systems. We first focus on the purpose of tagging and the incentives for users to tag educational resources. Then, we compare the most used tags in each system. We find that even if the tagging system design decisions differ, there is a number of similarities in tags that are shared among more than one of the services. Moreover, our goal is to discuss the reuse of tags across these systems and use them as a navigational aid for a user to cross system boundaries.

Keywords: Educational resources, tags, tagging systems, reuse.

1 Introduction

End-user generated tags for learning resources in a Learning Object Repository (LOR) can be seen as part of the dialogue for the co-construction of knowledge and individual's participation in social interactions [1, 2]. Studying LORs and tags from that point of view is possible when adapting Activity Theory as a theoretical framework [2]. Margaryan and Littlejohn claim that it offers a holistic framework that allows to study LORs and communities as a single system, rather than as a loose set of instruments, subject, objects and outcomes [3].

Using such framework Margaryan and Littlejohn studied learning resource repositories to analyse their barriers and enablers [3]. One barrier was the mismatch between how repository curators and users perceived the services. Authors argue that curators' repository-centric perspective frequently leads to

introduction of repositories as stand alone tools to users. However, they note, repositories are not used in isolation. They are part of the repertoire of tools that individuals and communities use to achieve learning goals. Therefore, they claim, the interplay between repositories and existing tools has to be considered.

We are interested in such interplay with existing educational offer, in this contribution our special focus is on tagging tools and their end products, tags, for educational content. We take a stand of a user who sees them only as one component within an entire repertoire of tools that she or he uses to achieve the learning goals. Therefore, inspired by the argument of [3] we study the possibilities for the interplay between a number of educational resources platforms (Calibrate, LeMill, OERCommons) and their tags in facilitating learners and teachers (i.e. end users) to achieve their set goals. In another contribution we conduct an early investigation for the interplay between educational resources platforms and content found elsewhere [4]. From a technical point of view, such interplay between repositories and their content is facilitated by the use of LOM [5] and Dublin Core [6] and tools such as federated search and harvesting [7].

We first explain our methodology and give details regarding the systems and dataset of the three different educational resources repositories. Section 3 discusses the differences and similarities between these systems and seeks to understand whether any commonalities are found that would justify the interplay of tagging systems in helping the end users in achieving their goals better. Our analyses show that despite some differences in the workflow and design, there are still a number of similarities that make sharing of tags, not only resources, interesting across repositories. In section 4 we will show that since the target audiences of the repositories are very similar, and since they share similar interests as explicitly indicated in tags, creating a cross-repository tagcloud consisting of data tuple of *resource-tag(s)* could enhance the interplay between the existing tools. A cross-repository tagcloud offer novel ways of social navigation not only across system borders, but also across language and national borders to make the offering of educational resources in multiple languages more accessible for learners and teachers. Section 5 concludes the paper with a short discussion and future work.

2 Three learning resource platforms and the dataset

In order to investigate the possibilities of using the end user generated tags as a way for end users to access learning content across applications, we first decided to study tags from different educational resources platforms. Early work on tagging systems has pointed out that different systems have different dynamics; [8] shows that system-level design choices and user incentives affect the nature and distribution of tags. Similarly, [9] demonstrate that tag input systems effect the nature and distribution of tags, as well as the uptake of the tagging activity. Is this also the case with different educational tagging systems, do different systems produce different tags due to their design decisions?

Table 1. Dataset description of repositories, * refers to the taxonomy of tagging systems proposed by Marlow et al. (2006). The shaded cells indicate similarities between features.

	Calibrate	**LeMill**	**OERCommons**
1. Time span of data	November 2006-November 2007	May 2006-December 2007	December 2006-official release in March 2007
2. # of resources tagged	682	3249	200
3. **# of tags**	920	3543	244
4. # of tags applied to resources	1282	9257	502
5. # of users tagging	142	436	91
6. Average of tags/resources	1,9 tags/resource	2.8 tags/resource	2,5 tags/resource
7. User incentives to tag*	"Keep found things found", personal retrieval	Share with groups; attract attention, future retrieval	Future retrieval, contribution and sharing
8. Objects types*	Textual, metadata of learning resources	User-contributed, self-authored resource (textual, non-textual)	Textual, metadata of learning resources, user-contributed
9. Source of material*	System, from educational repositories	User	System, from educational repositories, users
10. Tagging rights *	Free-for-all tagging	Self-tagging, free-for-all	Free-for-all tagging
11. Tagging support*	Blind / viewable tagging	Blind tagging	Viewable tagging
12. Resource connectivity*	None	Grouped, linked	Liked
13. Social connectivity*	None	Grouped, linked	Grouped
14. Other annotations	Rating, comment (public/private)	Teaching/learning story	Ratings, my notes
15. Create a collection	Favourites = bookmark+tags	Collections, no tags related	myPortfolio, add tags possible
16. Language of tags	Multiple languages, users from 5 countries	Multiple languages, users from 39 countries	Mostly English, users from different countries

To answer the question we first need to study the educational tagging systems. We apply the taxonomy by [8] to describe them in a uniform way so that we can compare the systems and their outcomes, tags. For a manual analyses of the tags we choose 20 most used tags from each service and categorise them using [9, 10] classification of factual, subjective and personal tags.

The learning resource platforms used for this descriptive and comparative study are the Calibrate portal, LeMill and OERCommons. They each share the same target audience, teachers, learners and educators, however, each of them mostly acts within its respective community of users. It was possible to obtain server-end log-files from each repository for learning resources that contained at least one tag. The following data was provided for each record: user ID, resource ID and tag(s). The dataset was acquired from each repository in December 2007.

CALIBRATE portal (http://calibrate.eun.org/merlin/). The Calibrate portal provides federated search over a number of educational repositories that belong to European Schoolnet and its associated partners. The portal was only available to pilot schools, but will later in 2008 be released freely under the name Learning Resources Exchange.

Users can search (free text and advanced) and browse educational resources through the portal and create their own collections of resources called "Favourites". Users can choose the interface language from ten different languages that can also be used for searching. The portal provides very little collaboration for users in terms of sharing their resources.

Motivation for tagging: Tagging on the Calibrate portal is related to the action of creating a bookmark to an interesting learning resources that the user wants to "keep found".

Purpose of tags: The purpose of tags on the Calibrate portal is purely personal and facilitates individual's future retrieval of interesting resources previously found on the portal. On the other words, a user is related to his own collection of resources through personal tags.

Table 2. Twenty most used tags in Calibrate

Tag	Lang	No of resources applied to	Category	No of users
Calibrate				
külföldi jó (good foreign material)	Hu	70	Subjective	10
külföldi közepes (average foreign material)	Hu	52	Subjective	10
külföldi gyenge (weak for.mat)	Hu	37	Subjective	11
Angličtina (English)	Cz	20	Factual, topic	3
Értékeltek (evaluation)	Hu	16	Subjective	2
Literatura (literature)	Cz	14	Factual, topic	2
Matematika	Cz, Hu	13	Factual, topic	7
Global problems	En	11	Factual	2
Test	"Travel well"	10	Factual, type	3
Vesmír (space)	Cz	7	Factual, topic	2
fyzika (physics)	Cz	7	Factual, topic	2
chemie (chemistry)	Cz	6	Factual, topic	1
english in general	En	6	Factual, topic	2
europa	"Travel well"	6	Factual, county	2
geometrie (geometry)	Hu	6	Factual, topic	1
fénytan (optics)	Hu	5	Factual, topic	1
animáció (animation)	Hu	5	Factual, type	4
evropa	"Travel well"	5	Factual,country	3
planety (planets)	Pl	5	Factual, topic	2
safety	En	5	Factual, topic	2

Discussion on tags: Table 2 lists the most used tags in the Calibrate portal, we can see that there is very little sharing apart from top three tags that are used as part of the Calibrate project. Low sharing is most likely due to the design decision of semi-blind tagging and the fact that tags are not displayed to other users. Also, we can speculate that the purpose of the tagging tool effects on this: many tags are used by one user to create collections of resources (e.g. chemistry or geometry).

And there is little convergent in the emerging folksonomy. Our manual analysis of the global tags in the Calibrate system reveals that 90% of them have been applied only once by one user.

From our previous analysis [11] we have learned that tags are mostly of factual type; they identify properties of the objects such as the topical area of the resource and some other attributes, seldom any qualitative properties. This trend is also visible in Table 2.

Interestingly, we find some coincidental sharing. The tag "Matematika" is shared by both Hungarian and Czech users because they share the same word in both languages. We also find some tags that, even if not translated, can be rather easily understood thanks to their similar spelling in many languages (e.g. literature, fyzika, chemie, europa, evropa). Lastly, we also identified tags that hardly even need translation (e.g. test). We loosely group these tags under the umbrella of "travel well" tags, as they propose added value for a multilingual users [11].

LeMill (http://lemill.net). LeMill is a web community for finding, authoring and sharing learning resources. It is divided to four sections: Content, Methods, Tools and Community. The main target audience is primary and secondary school teachers, but anyone can join. Registered users can publish learning content and descriptions of educational methods and tools. It is a wiki-like system where all the learning resources are published under open licence and can be edited by other members.

Table 3. Twenty most used tags in LeMill.

Tag	Lang	No of resources applied to	Category	No of users
LeMill				
calibrate		136	personal, shared	36
r		116	personal, shared	4
algebra lineal (linear algebra)	Sp	97	Factual, topic	19
projektijuhtimine (project mgt)	Et	82	Factual, topic	2
matemaatika	Cz, Hu, Lt,.	69	Factual, topic	16
lemill		65	personal, shared	15
kõneravi (speaking disorder)	Et	64	Factual, topic	6
a first course in linear algebra	En	54	Factual, topic, level	10
hambad (teeth)	Et	49	Factual, topic	2
algebra	"Travel well"	48	Factual, topic	7
matematika	Cz, ..	47	Factual, topic	12
geomeetria	Et	46	Factual, topic	1
traduccion	Sp	44	Factual, topic	8
felvilágosodás (enlightenment)	Hu	38	Factual, topic	1
linnud (birds)	Et	38	Factual, topic	16
логика (logics)	Ru	38	Factual, topic	21
algõpetus (pre-Kindergarden)	Et	38	Factual, level	2
dfl07tallinn		37	personal, shared	1
english	En	37	Factual, topic	21
Birds	En	33	Factual, topic	10

Motivation for tagging: Tagging in LeMill is part of the content authoring workflow that includes creating the resource, adding metadata and publishing the resource. Tags are not required by the system, like metadata keywords. The main motivation for the content creator to add tags is sharing the resource with other users. Second, tags help attract attention to creator's content through the tagcloud, which has a central role in the navigation. Last, content creators can use tags as personal management tool to keep their own resources organised, personal tagcloud can be accessed through user profile.

Purpose of tags: Tags in LeMill have the main purpose to be visible in a tagcloud, one of the main navigation tools. Similar cloud-like navigations have been created around other metadata too, like language, subject area and intended audience. Tags are also a way to contribute to the system and share resources among groups.

Discussion on tags: We can see an example of sharing through tags in Table 3 (e.g. like calibrate, r , lemill and dfl07tallinn). These are tags decided upon a community that allows sharing the resources later, and to aggregate a thematic collection around a tag. Even if these tags are powerful for sharing and retrieving resources among that group, they are less descriptive for the global audience.

Table 3 also reveals less-formal groups or ad-hoc communities that have formed around some resources (e.g. matemaatika and matematika). These tags can also be "travel well" tags, as they are shared by different language communities. Tags in LeMill also seem to be used for personal management to create own collections, e.g. "projektijuhtimine" (2 users), "hambad" (2 users), geomeetria (1 user) and "felvilagosodas" (1 user).

OERCommons (http://www.oercommons.org). The OERCommons allows users (teachers and professors from pre-K to graduate school) access and share course materials and learning resources that are harvested from a number of collaborating educational repositories around the world, and also added by users. Anyone can access resources, a number of search features are made available (text, advanced search, browsing topics and tags). Additionally, by signing in the users are offered more features such as creating their own collections, add tags and sharing their material with other users.

Motivation for tagging: The OER Commons encourages users to add searchable metadata, such as tags, to create user's own keyword vocabulary. The motivation for tags is similar to what [1] calls "Contribution and sharing: to add to conceptual clusters for the value of either known or unknown audiences".

Table 4. Twenty most used tags in OERCommons

Tag	Lang	No of resources applied to	Category	No of users
OERCommons				
biology	En	20	Factual, topic	15
art	En	11	Factual, topic	3
globalization	En	10	Factual, topic	3
psychology	En	10	Factual, topic	3
media	En	9	Factual, topic	4
internet	"Travel well"	9	Factual, topic	5
writing	En	8	Factual, topic	4
science	En	8	Factual, topic	6
civil society	En	8	Factual, topic	3
flu	En	7	Factual, topic	1
education	En	7	Factual, topic	6
evolution	En	7	Factual, topic	6
urban	En	7	Factual, topic	1
engineering	En	7	Factual, topic	4
algebra	En	6	Factual, topic	6
eLearning	En	6	Factual, topic	2
environment	En	5	Factual, topic	3
chemistry	En	5	Factual, topic	4
research	En	5	Factual, topic	3
french	En	5	Factual, topic	3

Purpose of tags: The OERCommons focuses on providing tags as an additional metadata that users can use to access resources. "MyTags", for

example, are available through the portfolio and also link to resources from other users with the same tag.

Tags also support discovery of resources, there are both a system and resource level tagclouds for navigation. Additionally, tags, when displayed next to conventional metadata of the resource description, can give additional cues to other users on the content and its use by creating a third-party conceptual cluster of tags.

Discussion on tags: From Table 4 we can see that there are some tags that are used by many users (e.g. algebra, evolution and education) indicating a small community forming around the topic. There are also tags that are used clearly only for personal indexing of resources (e.g. flu, urban). These both provide added value also for the other users though the tagcloud and resource-specific tags. Tags in Table 4 are all factual, the type of tag which ads high value to other users. Additionally, tags are all in English, which indicates that most users either have English as mother tongue or use English to facilitate sharing.

3 Comparison of tagging systems and tags

We now compare our findings to note similarities and differences between these tagging systems. We base our comparison of tags and their semantics on a manual, qualitative log-file analysis to better understand whether more elaborate further analyses would yield interesting outcomes. We will see that these educational tagging systems, when positioning them in the dimensions of the tagging design taxonomy by [8], represent rather different type systems on almost similar to the comparison of del.icio.us vs. Flickr in [8].

3.1 Differences

There are a number of differences between the tagging systems and they are easily viewable in Table 1. We have highlighted similarities in each category.

The incentive for tagging is different in each system: In Calibrate, tags are purely for personal retrieval purposes (Favourites), whereas in LeMill tags have the purpose to attract other users (tagcloud) and share resources. In OERCommons, on the other hand, tags are searchable, additional metadata.

Table 6. Number of tag/resources

Tags / resource	LeMill	OERCommon	Calibrate
1 tag	28%	41%	80%
2 tags	22%	18%	15%
3 tags	20%	22%	3 more 5%
4 tags	14%	6%	
5 tags	8%	7%	
6 or more tags	7.48%	6%	

When we look at how users tag, we find also wide differences between Calibrate on the one hand, and LeMill and OER Commons on the other hand

(Table 6). 80% of users in Calibrate have only applied one tag to a resource, whereas in LeMill and OERCommons, users apply clearly more tags to resources. In LeMill, where the creator of the resource mostly adds tags, about 75% of resources have two or more tags. In the OERCommons about 60% of resources have more than one tag. The same gap is seen the average of tags per resources (number 6 in Table 1), where the Calibrate portal is lower than the others.

The tagging rights and types of objects to tag also vary; here it is LeMill on the one hand, and Calibrate and OERCommons on the other hand. LeMill is a clear example of self-tagging (like Flickr), where the type of object being tagged is typically a resource or a reference created by the user. In Calibrate and OERCommons, users mostly tag resources that are created by someone else and already exist in the system (like in del.icio.us). In both of the latter users actually tag only the metadata reference of the resources, which might reside on some other educational repository.

If we look at the nature of tags in each system, we can see that in OERCommons tags are very factual and somewhat more convergent. We think that this is probably due to visibility of tags (tagclouds and related tags are displayed). In Calibrate, however, we find a number of tags that are more subjective (Table 2. 1,2,3), due to common project activities. This is also the case in LeMill, where we also find some top tags that are shared among users who share same project initiatives or meetings (Table 4. 1,2,5). However, like in the OER Commons system, we can see more convergent folksonomies in LeMill.

We can also see differences in the languages in which people tag in each system. The most used tags in OERCommons are in English, whereas in Calibrate and LeMill we can observe tags in different languages that reflect the user base of each system.

3.2 Similarities

Although there are many differences in design decisions on the system level, the purpose of tags in each system, and the incentive schemes for users to tag, in our small sample of most used tags (20), we find that they are very similar in their nature. Majority of them are factual, and represent properties that might be useful for other users of different educational system. We speculate that this is due to the similar target audience of the systems, rather than the inherent differences in the tagging systems as explained above.

We manually compared the most used tags among the three tagging services (60 tags). We looked at them on a pairwise basis, e.g. comparing services to one another, as done in [12]. The pairs were Calibrate-LeMill, Calibrate-OER and LeMill-OER. 18 tags appeared in more than one service (Table 5). These 18 contained semantic similarities that we were able to note: they covered similar topical areas (e.g. biology, Birds, linnud) or same topic in different languages (e.g. chemistry, chemie). The number of common tags appearing in each pair of tagging service is Calibrate-LeMill (8), LeMill-OER (8) and Calibrate-OER (4).

Table 5. Tags that appear in more than one service. The highlights show semantic similarities.

	Tag	Repository	No of applications
1	biology	OER-Calibrate	20
2	Birds	LeMill	33
3	linnud (birds)	LeMill	38
4	english in general	Calibrate	6
5	english	LeMill	37
6	Angličtina (English)	Calibrate	20
7	chemistry	OER	5
8	chemie (chemistry)	Calibrate	6
9	geomeetria	LeMill	46
10	geometrie (geometry)	Calibrate	6
11	Global problems	Calibrate	11
12	globalization	OER	10
13	algebra	LeMill	48
14	algebra	OER	6
15	gebra lineal (linear algebr	LeMill	97
16	matemaatika	LeMill	69
17	Matematika	Calibrate	13
18	matematika	LeMill	47

A notable similarity between tags in each system is that they very much cover a number of the topical areas that are shared among many of the educational systems (e.g. mathematics, science). We find that tags like algebra appear among top tags in LeMill (48) and OERCommons (6), which is also used in Calibrate (4).

Additionally, there are "travel well" tags that we have found in each repository. These tags can be found useful thanks to their similarity in spelling in many languages. These are place names (e.g. Europe, Italy), names of people (e.g. Pythagoras, da Vinci) and commonly known acronyms (e.g. AIDS, USA). They are easily understandable in many languages and do not always need to be translated, thus powerful in a multilingual context.

4 Sharing tags across educational tagging systems

In the above we have been able to demonstrate that despite design differences in tagging systems, the tags in all three educational platforms still share strong similarities. Our small sample size suffices to demonstrate the concept for the interplay between educational platforms; a commonly created cross-application tagcloud as a display of individual's participation in social interaction and co-construction of knowledge about the available educational resources.

Figure 1 represents an example of an aggregated tagcloud comprised of twenty most used tags from each tagging system. Each tag creates a *tuple of resource-tag* defining an implicit relationship between resources through the tags. Each repository could offer such a tagcloud in addition to their own system-based tagcloud(s). This cross-platform tagcloud would, for example, allow users to access a collection of 968 most tagged resources, thus creating a community based recommendation.

In Figure 1 the tag "algebra" is highlighted. The user sees that it is from LeMill and by clicking on it the user is taken to LeMill search interface with a list of 48

resources related to this tag. Thus, almost seamlessly to the user, she has crossed over the system border to another repository, and finds resources that users in LeMill community have indicated suitable to be used for algebra.

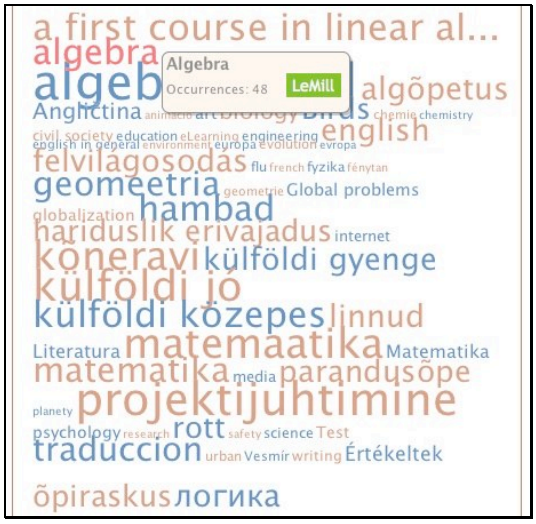

Fig. 1. Cross-repository tagcloud created by ManyEyes[2].

5 Discussion and Future work

In this paper we have introduced the concept of cross-repository tagcloud to enhance the interplay between the tools that learners and teachers use to achieve their learning goals. The idea to allow users to access resources originating from different repositories through tags is complimentary to other forms of sharing learning resources between repositories [e.g. 7]. Our proposal builds on the social interactions among users in terms of co-construction of tags and using them as a way to offer social navigation across educational resources platforms.

The tagcloud in Figure 1 is very basic. We chose to display the most used factual and some subjective tags in multiple languages from each repository, but left out the personal tags (e.g. "todo", "toread") as they add little value for the users of other repository. Obviously, more in-depth work is needed for further pair-wise comparison of tags across repositories to understand their similarities and differences, but also intellectual value, as discussed in [13].

Secondly, to make the user experience more coherent for the learners and teachers, the integration across applications can play an important role. Similarly as in the social software scene where users are offered tools to track their participation on diverse applications (e.g. User Labor Markup Language, ULML[3],

[2] http://services.alphaworks.ibm.com/manyeyes/view/SmAgULsOtha6fKFt2ZohL2~
[3] http://userlabor.org/

Attention Profiling Markup Language, APML[4]), these tools could be offered for learners and teachers to keep track of their attention and participation (e.g. content and communication in a large sense) across educational applications. This requires efforts from the educational application and service providers, for example, to generate metadata regarding user's attention and participation within their application. Interoperability and data portability become crucial for the reuse of data by the already available tools.

If such user generated metadata regarding users' attention on learning resources were made available, it could also be used to enhance the more conventional ways to harvest and/or federate educational content among repositories. Instead of harvesting and/or federating large quantities of anonymous learning resources metadata without knowing how users have previously perceived/used these resources could yield to the selection of resources that is guided by users' social interactions and co-produced knowledge (e.g. annotations like ratings and tags). This would open new interesting avenues for Social Information Retrieval for Technology Enhanced Learning across application boundaries.

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