# Can Social Information Retrieval Enhance the Discovery and Reuse of Digital Educational Content?

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## ABSTRACT

This paper gives an extended abstract of the dissertation work seeking to find how social information retrieval can enhance the discovery and reuse of digital educational content. A social bookmarking and tagging tool, that is used in a multi-lingual and multi-cultural context of Europe, is introduced to teachers. We intend to use this information to create social information retrieval mechanisms that allow flexible access to large-scale collections of digital educational content.

A first step towards studying the design and implementation of such systems is to understand more about tagging in multiple languages, its underlying data structures, and how multi-lingual tags and annotations can be leveraged for social information retrieval, such as for a recommender and a social navigation system. Thereafter, we plan to study their acceptance, use and usefulness.

Moreover, our goal is to make the discovery of digital educational content more useful and efficient for teachers by studying the relationship between different information seeking tasks and retrieval methods. We believe that this can facilitate, support and enhance the everyday tasks of teachers and learners when interacting with digital content for education.

## Categories and Subject Descriptors

H.3.3 Information Search and Retrieval: Search process, H.3.5 Online Information Services: Web-based services, J.4 SOCIAL AND BEHAVIORAL SCIENCES: Sociology, H.5.2 User Interfaces: User-centered design: User-centered design.

**General Terms:** Design, Experimentation, Human Factors.

**Keywords:** Social information retrieval, social recommenders, social navigation, tags, annotations, digital repositories, information seeking.

## 1. INTRODUCTION

European education, especially that of K-12 education, is inherently multilingual and multicultural. Offering educational resources and services in native languages is deemed important, but equally important is the exposure to other languages. Despite the use of well-defined metadata for digital learning resources, the end-users have difficulties to discover and find resources from educational repositories. Moreover, locating suitable content across linguistic and national borders within Europe has proven challenging despite the use of a multilingual Thesaurus[1] for controlled vocabularies.

As recommenders and social navigation systems move into new areas such as technology and network enhanced learning [6,8], the end-user perspective becomes increasingly important for a successful implementation. We think that implementing a social navigation system and a recommender based on social bookmarking and annotations can offer potential advantages for teachers across Europe. However, there is little evidence or guidance available as to how to treat tags in multiple languages and how to deal with potential cultural influences of annotations and ratings. To leverage the social aspects of a European-wide network, tags in different languages should not be kept in separate silos; rather interaction between languages should be used for connecting like-minded people across national and linguistic borders.

To make such a system is useful for teachers, it becomes of utmost importance to understand what the tasks are for which a teacher uses the system and how the intention gap between the user and the system can be bridged. The Human-Recommender-Interaction framework [7] argues that each recommender algorithm has specific strengths and weaknesses. Thus specific recommender algorithms perform better in relation to specific tasks that users have when they use a recommender as part of their information seeking practices. Similarly, we could assume that different social information retrieval methods, such as recommendation systems and social navigation, work better in different information seeking tasks and are more suitable for one specific task than any other method.

The rest of this paper is organised as follows. In Section 2 we describe the context of work and reasons for pursuing it. Section 3 gives a brief outline of current concepts to situate the dissertation. Section 4 describes the experimental design and Section 5 covers an up-date on the current work. Lastly, Section 6 concludes with our expected contributions to the field.


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[1] http://insight.eun.org/ww/en/pub/insight/interoperability/learning_resource_exchange/metadata.htm

## 2.CONTEXT OF WORK

The implementation area of this dissertation work is in the intersection of education, digital content and digital libraries. We are interested in introducing social information retrieval (SIR) and information seeking theories into this arena to leverage the social and contextual aspects of teachers' work.

By SIR we mean a family of techniques that assist users in obtaining information to meet their information needs by harnessing the knowledge or experience of other users. Examples of SIR techniques that this dissertation work is concerned with are collaborative filtering, social bookmarking and the use of subjective relevance judgments such as tags, annotations, ratings and evaluations. Information seeking, on the other hand, focuses on the process of obtaining information, where users may have different intentions for finding information [5,7,9].

Since the late 1990's, digital repositories for learning purposes have gained ground, and such repositories with metadata and/or content have been set up on regional, national and international levels to offer content for teachers and learners from K-12 to tertiary and vocational education [12]. Our work is situated in a European-wide federation of national and regional educational repositories managed by Educational Authorities (e.g., Ministry of Education, National Board of Education). This federation is run and managed by European Schoolnet, a consortium of 27 European Educational Authorities in K-12 education.

Our previous work in the field of learning repositories has focused on the variety of rating and evaluation approaches that repositories use to evaluate digital content [13]. We also undertook a simulation experiment to find which multi-attribute utility algorithm is more appropriate for implementing a collaborative filtering service within the portal of European Schoolnet [6]. However, at the same time we realised the limitations of our work: relying solely on the rating and evaluation grids in an educational context might not be the only correct source for defining similarity among users. Also, we were interested in adding more social context to our work, for which we found that ratings offered little support. Moreover, we lacked the information to find out whether a given resource was deemed to be relevant for an information seeking task that the user had, and whether it was found useful for that given purpose.

As part of our work to overcome the above identified shortfalls, we introduced a personal bookmarking and tagging tool in early 2007. It is part of a pilot which 78 schools from Hungary, Austria, Estonia, Czech Republic, Lithuania and Poland participate. This tool, which is made available in all languages of the pilot schools, allows teachers to create personal collections of learning resources by bookmarking interesting resources found through the portal. To facilitate the management of these personal collections (called "favourites" in the project), the user can add keywords to resources to make it easier to "keep found things found". These keywords are free for the user to choose and can be expressed in any language(s). The collections and keywords are kept private to the user, and at this stage of the experiment, they cannot be shared among users. However, we encouraged the use of rating and commenting, which are public.

All user interactions are recorded on the portal's data logging system in order to better understand the patterns of what users do, how they search, rate and bookmark and how they could be better helped. More importantly, we are interested in studying user intentions. After all, teachers have a variety of information seeking processes that are both contextually and socially driven. The context of work is derived from national or regional curricula, their topics, goals and learning activities. Whereas for the social aspects we can list items such as the accepted and negotiated educational practices and pedagogies, cues from colleagues, parents, etc.

## 3. CURRENT CONCEPTS

The dissertation work builds upon two main concepts; on the one hand, we are interested in the network properties of social bookmarks and multi-lingual tags, and how they can be used for social navigation and recommendation [1,2]. We are also interested in how the community can influence its members in the process of applying tags, and what its effect on tagging is in multiple languages [10, 11].

On the other hand, we want to understand what information seeking tasks drive users to a learning content repository and how best to apply SIR techniques to build a relevant, useful and effective system to support and enhance the discovery of digital content [5, 7, 9].

## 4. EXPERIMENT DESIGN

The setting-up of the experiments for this dissertation work takes place in two somewhat parallel settings, which also create two different experimental conditions, namely the social independent condition and the social influence conditions (Table 1) [10]. This allows comparative analysis of a number of our research questions. Our focus is twofold, on the one hand we are interested in the act of applying tags in multiple languages (called Tagging in Table 1), and on the other hand, we focus on how these tags are used and perceived for retrieval purposes (called SIR in Table 1).

**Table 1. Experimental design**

| | **Independent condition** | **Social influence condition** | |
|---|---|---|---|
| Tag-ging | Semi-independent condition for tagging (if tags available they are seen) | Social condition for multi-lingual tagging | Social condition for tagging in known languages |
| SIR | Ranking based on bookmarks, ratings and tags | Social navigation based on bookmarks, ratings and tags | |

The first part of the experiment on tagging takes place in a so-called independent condition (left part of Table 1) where there is no or very little community influence available. Similar to the set up in [10], these subjects have no social clues from other users in terms of what resources to bookmark. When applying tags to bookmarks, subjects are shown tags only from their own language group, if any are available (e.g., a user using the interface in Polish will only see tags in Polish, if any are available. No tags in any other languages are exposed).

This system, which is currently available, is made available for the subjects of the independent condition and only offers conventional information retrieval. Additionally, personalised ranking of search result lists is currently being tested, which is based on input from bookmarks, ratings and annotations (tags and comments). This technical implementation does not fall under our dissertation work, but we will study how users use this special feature, how its usefulness for information retrieval is perceived and whether it enhances the re-use of resources.

The next part of our experiment introduces social features to the portal, which allow our subjects to take advantage of the presence of other users and their digital traces on the portal. This is called social influence condition (right side of Table 1).

We are interested in studying how the social influence condition can affect tagging behaviour, the characteristics of tags and their convergence, as in [11]. Our context being multi-lingual, however, we are also interested in how the community can influence the behaviour of tagging in different languages, and for example on the convergence of languages.

For the latter, the subjects of the social influence condition are further divided in two different groups. While adding a tag to a bookmark, the first group will be exposed to tags from previous users in all available languages. The second group is able to see the previously used tags in all languages which they have indicated they have competencies (this information is stored in the user profile, most subjects indicate competencies in 2 to 4 languages). The aim of this second division is to study how subjects react to multi-lingual tags in multiple languages, the types of tags, their convergence, as well as how users perceive and accept the multi-lingual nature of tags.

As for the retrieval of resources, the subjects in the social condition are given information about the behaviour of the other participants by exposing them to the most bookmarked items and the number of bookmarks on each resource. Also, social navigation elements such as navigating multi- or mono-lingual tag clouds and browsing other users' collections are added. Users can also create their own personal networks. We will study how these influence how users access and re-use resources.

Lastly, our interest also lies in better understanding our target users' information seeking intentions and the relation of chosen search methods [5, 9]. We will study whether there are any patterns in what SIR method is chosen for what type of tasks, and if this could lead us to propose the best suited SIR method for a given task.

Educators divide their time among three main tasks: preparation of lessons, the delivery (i.e. the actual teaching) and evaluation. For example, to prepare a lesson a teacher has a variety of information seeking tasks, such as finding content to motivate the learners, to recall existing knowledge, to illustrate, visualise and represent new concepts and information, etc. The group of pilot teachers will be given different tasks. We use the system's data logging feature to track how different retrieval methods are used to fulfill a number of tasks. Additional focus group interviews are planned to better understand how teachers' intentions were supported.

Ideally, we should be able to express different tasks and find a best matching social retrieval method. If a task is to find curriculum coverage content for a lesson, for example, a teacher might want to follow recommendations from other teachers who work in the same curriculum area. On the other hand, a teacher who is looking for motivational material might want a list of recommendations that is based on like-minded users from all over Europe. The most useful method to find that information could be browsing bookmarks from identified like-minded users.

# 5. CURRENT STATUS

The first three months of data gathering from the users in independent condition resulted in about 13000 interactions on the portal, where 460 bookmarks and about 600 tags were added. One third of these tags were in Hungarian, another third in German and Polish and 26% in English, even though none of the users were native English speakers. Two types of early analysis have been run on this data: first, semantic analysis of multilingual tags and their acceptance by users, and second, we observed some early impressions of the level of user engagement with the portal and its resources.

## 5.1 Semantic analysis of multilingual tags and their acceptance by users

For our first preliminary semantic analysis of tags we translated them into English in order to study the types of tags. We used the three tagging categories from [11] that are also based on [3]. The vast majority of the tags (93%) at this early stage are of the factual type. From the factual tags, 79% were put into a rough category of topic and 14% of the category refinement with richer information. The rest of the tags (7%) were subjective and could be used to describe the quality of the resources or how the person felt about them. None of the tags fell into the category of personal tags as Golder describes them (e.g., tags related to item ownership, self-reference or personal tasks organisation). When we analysed how these tags were re-used, we found that 80% of tags related to bookmarks were factual and 20% of the tags were subjective in nature. In a MovieLens study [9], for comparison, the distribution was 63% factual, 29% subjective, 3% personal and 5% other.

We also used the tagging data to run an experiment on the acceptance of multilingual keywords by a focus group of teachers [14]. Their task was to evaluate five metadata records of learning resources that contained both multilingual tags and indexation keywords from a Thesaurus. The results of this early study suggest that some multilingual tags scored as high as the Thesaurus terms for their usefulness for describing and indicating the possible use of the resource. However, users were divided about the benefits of multilingual tags (50-50) for retrieval purposes (note, we did not study any social aspects here).

Interestingly, we also identified that about 15% of tags “travel well” across linguistic borders. They consist of names, places, general terms, etc. that have roughly the same spelling in many languages. This indicates that some multi-lingual tags, even if they are not in languages that users have competencies in, were found to be useful. Thus, hiding all but the right tags becomes crucial for the success of a multilingual collaborative tagging system.

## 5.2 Levels of user engagements

We were also interested in early analysis of user engagement with the portal and its resources. When analysing the tags, to our surprise, we found that a bookmark does not always mean a positive vote for the content. We found that on some occasions, even though the user had bookmarked the resource, it had negative tags or a low rating added to it. This was contrary to our hypothesis, which is that a bookmark demonstrates a positive vote. This finding made us question the purpose of bookmarking for teachers. This needs further investigation, but we assume that rather than a positive vote for a resource, a bookmark indicates that the resource, although not perfect, was found useful among the content that was available.

This lead us to take a closer look at the interactions leading to the act of bookmarking (Table 2) and towards a way to measure users' engagement with the system, its metadata and resource itself [9]. In a small analysis we observed that users often looked at the resource itself, rather than the metadata [4], and about 5% of views of resources resulted in bringing the item in bookmarks.

**Table 2: User interactions in 31 days**

| | |
|---|---|
| View item | **2481** |
| Search | **1276** |
| View details | **347** |
| View all details | **325** |
| Bookmark | **127** |
| View Ratings | **46** |
| Rate | **10** |
| Delete bookmark | **29** |
| **Total interactions** | **4641** |

We are further interested in defining levels of engagements (e.g., Yahoo!'s "START" [9]) in order to weigh these interactions for the purpose of using this information to produce additional input for a recommender. According to START, the act of rating shows the first level of engagement; followed by tagging; then the user views a page; forwards it to friends, and finally writing a review, blog article, etc., which shows the highest level of engagement.

We can already assume that the levels of engagement are different in our context from START. It seems that viewing the resource expresses a low level of engagement with it, whereas bookmarking, tagging and rating shows a rather high level. The highest level could arguably be the real-world use in an educational context. We will investigate this hypothetical pattern further, as it can have implications on how the different inputs are weighted for the purpose of recommendations.

# 6. EXPECTED CONTRIBUTIONS TO THE FIELD

It is too early to speculate on the final contribution of this dissertation work. However, we wish to outline potential areas where this work can contribute.

Better understanding of tags in a multi-lingual context, and their use by people with multiple language skills, will offer valuable knowledge. When the recommender environment, for example, reflects the linguistic competencies of its users, it has a strong effect on the user perception of the recommender [7]. Moreover, discussing the search process and use of languages that the user feels comfortable with, [5] has suggested that the emotional state of the user is as important as the information the user finds. Thus, this study will also seek to contribute to a better understanding of multi-linguality in the discovery process.

Moreover, this dissertation work attempts to make a contribution to the area of technology and network-enhanced learning by introducing new ways to harness the power of users and their networks for the discovery and reuse of educational content. We seek to understand the usefulness of these methods from an education-specific perspective by better understanding the information seeking tasks, as well as by better matching a method that serves to address those needs.

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