

# Enhancing Social Tagging with a Knowledge Organization System

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## ABSTRACT

The paper investigates the effect on indexing and retrieval when using only social tagging versus when using social tagging in combination with suggestions from a knowledge organization system. The specific context is that of tagging by Web document readers, using Dewey Decimal Classification, its captions, Relative Index Terms and Library of Congress Subject Headings mapped to the captions. The results showed the importance of knowledge organization system suggestions for both indexing and retrieval: to help produce ideas of tags to use, to make it easier to find focus for the tagging, as well as to ensure consistency and increase the number of access points in retrieval.

## 1. INTRODUCTION

Knowledge organization systems such as classification schemes and thesauri have been used as tools for information discovery and retrieval in libraries and abstracting and indexing services, some for more than a century. They are designed to reduce the ambiguity of natural language when describing and retrieving documents, and to allow access via browsing and navigation. However, manual indexing and classification pose significant resource costs, especially when performed by trained indexers. Automated means and social tagging are often suggested as the two possible solutions. Both, however, have disadvantages and, depending on the purpose of use or context, require additional manual input. Social tagging applications, such as Flickr and Del.icio.us with their community-based user interfaces encouraging social tagging activity, currently attract much attention and are seen as key elements of new Web 2.0 services. They hold the promise of reducing indexing costs by drawing end-users into contributing, adding value as part of their interaction with information services. However, many of the existing social tagging applications have not been designed with information discovery and retrieval in mind – people tend to use tags mainly to organize their documents [24]. The resulting folksonomies (collections of tags) lack basic control of word forms such as spelling variants, synonyms and disambiguation of homonyms ([8], [23]). Thus, the need for knowledge organization systems in relation to folksonomies has also been reported in the literature; at the same time, end-user natural language tags could cover aspects that are not available in a knowledge organization system, especially when it comes to new concepts ([19], [21]).

EnTag (**Enhancing Tagging** for Discovery) [5] was a one-year UK's JISC-funded [15] project that investigated ways of enhancing social tagging via knowledge organization systems, with a view to improving the quality of tags for increased information discovery and retrieval. Two major objectives were the following:

- Investigate indexing aspects when using only social tagging versus when using social tagging in combination with a knowledge organization system;
- Investigate the influence on retrieval of only social tagging versus social tagging in combination with a knowledge organization system.

The remainder of this paper discusses related work (section 2), the methodology (section 3), results (section 4), and conclusions with recommendations for future steps (section 5).

## 2. RELATED WORK

The need for knowledge organization systems in relation to folksonomies has been reported in the literature. Noruzi [18] provides seven arguments for why a folksonomy-based system should use a thesaurus, emphasizing that it is impossible to maintain consistency over time or across folksonomy users without a thesaurus. Several social tagging applications and projects have recognized the problem of folksonomies and tried to implement solutions outside the area of traditional knowledge organization systems. For example, an add-on tool has been developed for Connotea [2] which allows taggers to select terms from a knowledge organization system [6]. Research aimed at integrating the worlds of folksonomies and knowledge organization systems has also been conducted. Smith [22] compared folksonomies in LibraryThing [17] and Library of Congress Subject Headings (LCSH) [16] and discussed the advantages and disadvantages of each. Trant and Bearman [25] compared end-user tagging of art against existing professional terms and found that the former increases access points. The Library of Congress is collaborating with Flickr [7], in order to enhance bibliographic records for its images by end-user tags [20]. However, as known to the authors, no research has investigated the enhancement of social tagging with suggestions from a knowledge organization system in a user trial with existing retrieval applications, comparing social tagging and enhanced tagging.

## 3. METHODOLOGY

### 3.1 Demonstrator

The main focus of the project was to examine whether and, if so, how social tagging can be enhanced with suggestions from a knowledge organization system. To that purpose a demonstrator was developed [4] and a user study conducted. An extract from the Intute subject gateway [14] was used in the demonstrator. The Intute subject gateway is a UK-based database of hand selected and catalogued Web documents for education and research. For each document the catalogue record comprises title, description, controlled keywords, uncontrolled keywords, classification, type, URL, format, etc. (see [13] for detailed cataloguing policy). In the study, 11,042 Intute catalogue records were chosen, all from the area of politics. Records were classified by the DDC, IBSS (International Bibliography of the Social Sciences) thesaurus [12] and HASSET (Humanities and Social Science Electronic Thesaurus) [10]. Uncontrolled keywords mostly comprise names of countries.

The demonstrator [3], developed at the University of Glamorgan, is a .NET application, employing Visual Studio, C# and ASP .NET. It operates over the extract of the Intute catalogue records held on the Glamorgan server. Original indexing and classification have been stripped out for purposes of the study. The URL to the web resource is provided so that the user can view the actual document.

The knowledge organization system from which suggestions are provided to one of the interfaces is the DDC which also comprises mappings to Library of Congress Subject Headings (LCSH). DDC contains so-called class captions (names of classes) and relative index terms pointing to the captions (entry terms represented by class captions). Thus, the suggestions offered come from three sources: DDC class captions, DDC relative index terms, and LCSH terms. It was decided to retain the original DDC terms in suggestions for purposes of the study (see section 4.1.2).

The demonstrator comprises three major interfaces: searching, simple tagging, and enhanced tagging. Once a person logs in, he/she arrives to the searching interface (Figure 1). The searching interface provides the following features:

- 1) Main Tag Cloud: a tag cloud with tags linked to documents to which they were assigned. It is an alphabetical list of all tags in the demonstrator, with different font sizes relative to popularity. Filter By

drop-down menu on top offers the My Tags option which presents the current taggers's tags only. By default everyone's tags are shown (Everyone's Tags).

2) Taggers: a cloud of names of taggers linked to documents they indexed.

3) A free-text search box, with an option to limit searching to tags, title and description fields.

The documents found are shown in the Results pane. They are automatically ranked according to the MySQL full-text natural language search. Title, description (from Intute) and existing tags are shown here. By clicking on the Title, the URL opens in a new window.



**Figure 1. Demonstrator's searching interface**

Once a document is selected from search results, clicking on the "Tag" button will return a tagging interface. Here title, URL, and description are displayed. Two tagging interfaces are provided: 1) the Simple Tagger, with tagging features common in popular social tagging applications; and 2) the Enhanced Tagger, with additional suggestions from the knowledge organization system. (In the study the log-on screen provides the choice of the interfaces). Both tagging interfaces have the following options from which to select tags (Figure 2):

- 1) Main Tag Cloud.
- 2) Taggers: names of taggers linked to tags they have used, the latter listed in the All {Tagger Name}'s Tags pane; and,
- 3) My Tags For This Document.

By clicking on a selected tag, the tag will be shown in the text box. By pressing the Tag Document button the tag will be added to the document as well as listed in the "My Tags for This Document" pane. A tag can also be typed in.

Enhanced Tagger (Figure 2) additionally provides suggestions from the knowledge organization system, presented in three panes at the bottom of the screen. In the first pane to the left ("Automatically suggested matches, Find appropriate context(s)"), DDC classes are listed. They are automatically derived by a string-matching comparison of DDC vocabulary to a user-entered term from the text box above the panes upon clicking the Suggest button. Immediately after the user comes to the enhanced

tagging page, initial suggestions are automatically generated by treating the document's title as if it had been entered as a tag.

If the user clicks on one of the listed classes from the first pane, its narrower and broader classes are shown in the second pane ("Explore hierarchy around the selected context"), allowing interactive browsing of the hierarchical context. Simultaneously, in the third pane ("Select/edit relevant tags") a tag-cloud-like list of DDC captions, DDC relative index terms and LCSH mapped terms is presented as a source of suggestions from which the user may select a tag. Selecting a tag copies it to the text box, where it can be further edited; pressing the Tag Document button adds the tag to the document.



Figure 2. Demonstrator's enhanced tagging interface

What follows is an example of how a tag is chosen from suggestions in the enhanced interface. After searching for the term "slavery" in all fields, a list of documents is returned. The document chosen is "Slavery in New York", an online exhibition on history of slavery in New York State (<http://www.slaveryinnewyork.org/>). By clicking on the "Tag" button, the enhanced tagging interface opens. In the text box in the middle of the screen the tag "slavery" is entered and the "Suggest" button clicked, to get DDC-based suggestions. As shown in Figure 2, the first pane then displays 19 matching classes. Two of these belong to political science. The "End of Political Science" line means that the classes below it belong to different subject areas from DDC, which could be related to politics. Mousing over each caption will display its immediate superordinate class. The top found classes are the following:

- Slavery and emancipation (*superordinate class: Political science*)
- Emancipation (*superordinate class: Slavery*)
- End of political science -----
- Discriminatory practices and slavery (*belonging to Ethics of social relations*)
- Extension of slavery (*belonging to Administration of Abraham Lincoln*)
- Slavery (*belonging to Systems of labor in Economic institutions*)
- American fiction-1830-1861, ... (*belonging to American literature*)
- Etc.

Since the document is about the slave trade and emancipation movement, “Slavery and emancipation” is chosen, which results in the second pane containing “Slavery and emancipation” highlighted, surrounded by its broader and narrower classes, each hyperlinked to further broader and narrower classes. The third pane lists tagging suggestions, those being captions, relative index terms, and LCSH mappings for the term. Clicking on a suggestion will automatically have it appear in the text box. There one can further edit it before clicking on the Tag Document button.

For our document the tags chosen from the third pane are:

- Antislavery movements - United States

- Emancipation

- Slave trade

- Slavery

Thus, apart from the initial “slavery” tag, by using the DDC suggestions, three other tags are gained. Furthermore, unlike in common tagging applications, these terms are controlled.

## **3.2 User study**

In order to compare simple and enhanced tagging an exploratory user study was conducted. It covered two main questions: 1) how a tag is chosen in the two different interfaces; and, 2) what are the retrieval implications.

### **3.2.1 Participants**

The study took place remotely at participants’ homes using their own computers, supported by communication via email. The participants were recruited mainly using a written call for participation which was sent out throughout the UK. It was emailed to mailing lists for politics students as well as to several dozen top-rated politics departments in the country. Initially, there were 61 participants who signed a participation consent form, and 54 who completed a pre-study questionnaire. Six participants took part in pilot testing. There were 42 participants who did at least some tagging but not everyone completed the whole study: 28 of them finished all tasks. The results reported here are based on these 28 participants’ input.

The participants were politics students from British universities. Based on a pre-study questionnaire, it was found out that they were experienced Web users. Half of them had used tagging applications before but conducted little tagging. Almost a third had some acquaintance with DDC; there were none with any acquaintance with LCSH or other knowledge organization systems. The majority have never used Intute.

### **3.2.2 Data collection**

The main data collection method was logging the participants’ steps in the demonstrator. In order to contextualize and understand the results further, three groups of questionnaires were also used: 1) a pre-study questionnaire, which served to collect background information about the participants (see previous section); 2) post-task questionnaires, to gather experience about each task as to familiarity with the topic, tagging in the task and interface features; and, 3) a post-study questionnaire, about the whole study and interfaces in general.

### 3.2.3 *The study procedure*

The procedure of the study comprised several steps. After signing the participation consent form and completing the pre-study questionnaire, the participants were given the training document through which they were to acquaint themselves with the demonstrator and tagging. They were also given the settings document describing how to enable scripting in Internet Explorer and Firefox browsers, and how to zoom the screen display for better viewing in Firefox. Then they received the instructions document which described the steps they were supposed to take.

The steps included 4 tagging tasks, each comprising 15 documents. The tasks were on topics from politics; two were pre-defined (controlled) and two on a self-chosen topic (free). The controlled task for simple tagging was on the topic of “European integration”, and for enhanced tagging on “peacekeeping”. A hypothetical group project scenario was outlined as a rationale and motivation for the tagging activity. The scenario for the controlled enhanced tagging task follows:

“Imagine that as part of one of your courses, you are asked to write a four-page essay on the topic of European integration, as a joint project in groups of four. The essay should critically discuss existing theories about the creation of the European Union and its institutions. Your lecturer has instructed you to look for resources in the EnTag system. Since you will be working together with three other students, you should tag the documents you retrieve with tags that would be useful to you but would also enable other students to find those documents in EnTag and understand from your tags what the documents are about.”

In each task they were first instructed to search for documents and then tag 15 of them. In controlled tasks they were asked to tag the top 15 retrieved documents; in free tasks they could choose any 15 that they found relevant. The analysis showed that 53 documents were tagged at least once in the controlled task, and 41 in the simple task (instead of 30 in each). This is because participants did not closely follow the ‘top 15’ instruction and because the URLs of some of the top 15 retrieved documents were temporarily unavailable. They were instructed to spend between 5 and 10 minutes on tagging each document, and to tag as many aspects and topics they thought appropriate for the task. They were also asked to open the URL, but did not need to follow further links. In case of long documents, they were instructed to focus on the abstract, introduction, conclusion, headings and table of contents. When tasks were being completed in the interface enhanced with suggestions from the knowledge organization system, the instruction was to try to consider those suggestions if appropriate (they did not have to follow the suggestions).

The order of tasks was rotated in order to reduce the learning influence.

## 4. RESULTS

### 4.1 Number of Tags

As seen from Table 1, in total 7568 tags were assigned in both interfaces and in all the tasks. More tags were assigned in Simple Tagger than in Enhanced Tagger, which could be explained by the fact that the participants, as they reported, spent more time in Enhanced Tagger due to exploring the different controlled suggestions, instead of adding the first tag that came to their mind. In Enhanced Tagger more tagging activity took place when the topic was freely chosen.

In controlled tasks on average 41 tags per document were assigned (for the 94 documents that were tagged), and in free tasks 5 tags per document (for the 751 documents – many more because typically fewer users viewed a given document since the search was freely chosen). This is similar to findings of [1] where on average four tags were assigned. Each participant assigned on average 278 tags in total, a few more in Simple Tagger and a few more in the free task, probably due to faster tagging process in Simple Tagger and more motivation in the free task.

**Table 1. Number of tags**

	<b>Simple</b>	<b>Enhanced</b>	<b>Total</b>
Tags in total	4022	3546	7568
Controlled task	2025	1688	3713
Free task	1997	1858	3855
Tags per document (controlled)	avg. 49 (41 docs)	avg. 32 (53 docs)	avg. 41 (94 docs)
Tags per document (free)	avg. 5 (374 docs)	avg. 5 (377 docs)	avg. 5 (751 docs)
Tags per tagger (controlled)	avg. 72	avg. 63	total avg. 135
Tags per tagger (free)	avg. 74	avg. 69	total avg. 143

## 4.2 Choosing a Tag

In simple tasks the majority of tags (90.9%) are assigned by typing them in directly, as common in social tagging applications. In enhanced tasks 71.2% are typed in directly, while 16.9% come from DDC-based suggestions instead.

The instructions for the enhanced tasks encouraged the participants to consider the suggestions if they thought them appropriate. While the figures should not therefore be considered a simple measure of popularity, some participants commented favourably on suggestions (see also 4.4 Post-Questionnaires):

- They appreciated the suggestions when they did not know the topic well;
- What they disliked about the Simple Tagger was that there were no suggestions;
- They understood the benefit of having controlled tags.

Selecting from another tagger's tags is a common feature in popular social tagging applications, and has been used in both of our systems, too – on average 7.6% of all tags assigned. Main tag cloud is yet another common feature, but has hardly been used at all (see section 5 Conclusions).

Table 2 shows where the participants looked for potential tags. In simple tagging the most frequent feature was others' tags, 72.9% in total (Certain Tagger's Name (18.9%) and Certain Tagger's Tag (54.0%)). Main Tag Cloud and Own Tag were less used (16.8% and 10.3% respectively). In enhanced tagging most frequent activities were the ones related to exploring DDC suggestions, 74.0% in total. Of other features, as in simple tagging it was others' tags that were most popular, 18.2% in total.

**Table 2. Browsing for tags**

<b>Activity</b>	<b>Simple N = 614</b>	<b>Enhanced N = 2468</b>
Main Tag Cloud Clicked	16.8%	5.1%
Own Tag Clicked	10.3%	2.7%
Certain Tagger's Name Clicked	18.9%	3.7%
Certain Tagger's Tag Clicked	54.0%	14.5%
Dewey Suggest Button Clicked		28.9%
Dewey TreeView Clicked (1st pane)		13.7%
Dewey Hierarchy Clicked (2nd pane)		3.2%
Dewey Suggested Tags Clicked (3rd pane)		28.2%
	100.0%	100.0%

Results showed that the 'raw DDC' is not necessarily appropriate to present online to end users. For example a number of DDC captions contain quite complex phrases, some of which are 'built terms' and require hierarchical context. Certain captions are unclear without displaying their coordinate, superordinate or subordinate classes. This can be due to captions' polysemic nature, brevity etc. In the demonstrator, superordinate classes are displayed. This has been implemented through mousing over the class. Suggestions to deal with problematic terms for a future study or demonstrator are being discussed in cooperation with OCLC.

## 4.3 Retrieval Implications

### 4.3.1 *Tags in Documents' Catalogue Records*

End-user tags were compared against three Intute catalogue records fields: document's title, URL and (manually created) description. These are the fields the participants could see when tagging. Because most of the catalogue records originally had manually assigned controlled keywords, and more than half of them also uncontrolled keywords (both hidden to the study participants), end-user tags were compared against the manually assigned keywords as well. The comparison was case-insensitive while spelling variations were not considered, i.e., each spelling variation was counted as a different term. The analysis showed that end-user tags, both from Simple and Enhanced Tagger, are found in 64% of tagged documents' title, URL or description. So, for 36% of the documents tags potentially present additional access points.

Most tags are found in the description (it being the longest piece of the catalogue record), followed by title, and then by URL. In addition, out of 143 documents to which tags from DDC suggestions were assigned, only in 17 documents were they found in title, 2 in URL, and 25 in description. This suggests that, in retrieval, enhanced tagging could potentially provide more access points (that are not present in the document text) than simple tagging when used in combination with a full text search engine.

There is also a very low overlap between simple and enhanced tags with pre-assigned Intute keywords – more than 90% of tags could serve as additional access points beyond the original Intute indexing. Of the tags selected from DDC, only a few overlap with existing Intute controlled keywords (these came from DDC, IBSS and HASSET thesauri): out of 598 DDC tags, 12 are contained in (or the same as) controlled keywords.

### 4.3.2 *Search Terms*

There were 98 search terms used in Simple Tagger, and 122 in Enhanced Tagger. In Simple Tagger, almost three times as many search terms are found in tags as in controlled keywords, and twice as many as in uncontrolled keywords. The difference is even bigger for Enhanced Tagger. The hypothesis that there is a greater probability of finding search terms in tags is an interesting avenue of future work. However, caution must be exercised since the study context might naturally encourage the use of search terms in tags, since tagging was always preceded by a search.

### 4.3.3 *Simple vs. Enhanced Tags*

A full qualitative analysis of the differences between tags derived from Simple and Enhanced Taggers is under way. One suggestive example is presented to illustrate one of the main lines of inquiry. It is a document where in Simple Tagger at the end of the study there was only one tag assigned by six different users: "afghanistan". In Enhanced Tagger the tags assigned were the following (the number after comma indicates the number of times the tag was assigned, and the ones in bold are DDC tags):

Afghanistan, 2

**Afghan War, 2001-, 1**

afghanistan and liberia, 1

**Afghanistan, 5**

**Afghanistan - 20th century, 1**

Afghanistan - Politics and government, 1

**Afghanistan - Politics and government - 1973-, 1**

afghanistan and liberia, 1

Afghanistan and Liberia - Civil rights, 1

afghanistan casestudy, 1

This illustrates that the suggestions from Enhanced Tagger can describe the document by more facets: time (20th century), specific event (Afghan war), politics and government.

#### 4.4 Post-Questionnaires

After each task, the participants completed a post-task questionnaire. In both Simple and Enhanced Tagger, the majority were on average familiar with the topic of the task, they found it easy to choose tags, were satisfied with tags assigned, and were certain that they assigned the tags correctly.

Of the tagging-support features, they found the following ones helpful:

- Listing of own tags;
- DDC disambiguation tree (first panel on the left bottom part of the screen); and,
- DDC/LCSH suggestions.

The ones they did not find as useful were:

- Main tag cloud;
- Clickable names of others; and,
- DDC hierarchical browsing for narrower or broader classes (bottom middle pane).

At the very end, the participants filled in a final questionnaire about the whole study. The majority enjoyed the study and believed that a similar system would be useful in real life. They thought it extremely or very easy to learn and use Simple Tagger and somewhat or very easy to learn and use Enhanced Tagger. Of the comments about Simple Tagger, they liked freedom to have own choices, its simplicity and speed. They did not like the fact there were no suggestions and the need to scroll in the main tag cloud. About Enhanced Tagger they liked suggestions when they thought them useful; they found them time-saving and valuable in particular when they were unsure of which tags to assign; and, they considered them important for consistency in indexing as well as searching. One participant preferred simple tagging when indexing a document on a familiar topic and enhanced tagging when a document is on an unfamiliar topic, suggesting how both are useful in different contexts. What they did not like about Enhanced Tagger were sometimes irrelevant suggestions, there were several comments on the cluttered interface and the number of interaction steps required to tag a suggestion. One or two experienced excessive scrolling when employing browser platforms the system was not optimised for. A few suggested that a streamlined version of Enhanced Tagger would be useful, with easier interaction and more selective focused suggestions.

## 5. CONCLUSIONS

The main focus of the project was whether and, if so, how social tagging can be enhanced with suggestions from a knowledge organization system. The study showed that most tags are added by typing them in directly, as is common in social tagging applications; of the other features used, the most frequent one is DDC suggestions, and another tagger's cloud. That the participants appreciate the DDC suggestions was also seen from their comments.

The main tag cloud, common in social tagging applications, is little used. Part of the problem is that there are too many options from which to choose and excessive scrolling due to the size of the cloud. This could be reduced by improved search/browsing and personalised ranking, clustering or filtering. However, it is not clear that displaying all tags is useful for retrieval purposes with large collections. In future work, we would like to investigate further single-document, all-user tag clouds, as well as tag clouds based on communities of friends/colleagues.

The study also showed that in enhanced tagging, while users appreciated the 'direct' suggestions (third pane) and made some use of the disambiguation interface element (first pane), they did not browse the Dewey hierarchy very much (middle pane). Further work is needed to explore when browsing functionality is desirable in this context.

In the study both simple and enhanced tagging provided additional entry points beyond the original subject indexing, as well as compared to free text search engines. There was some evidence that, in particular, controlled suggestions provided additional access points beyond the literal text. That tagging contributes has also been found in earlier research ([25]).

User experience and task completion showed that the demonstrator was usable with little prior training. However comments showed that the interface, particularly in the Enhanced Tagger was experienced as complex. By design the interface was cluttered because a variety of tagging features was to be tested. An operational system should have a simpler, less cluttered user interface, focusing on the key functionality and with user interaction streamlined. It is important to further analyze, experiment and pilot test tools derivative from the demonstrator.

We find the approach promising and intend to follow it up in future work.

## 6. ACKNOWLEDGMENTS

This work is funded by UK's Joint Information Systems Committee (JISC) Capital Programme. Thanks are due to Intute for supplying an extract of their social science collection and to Diane Vizine-Goetz, Andrew Houghton, Michael Panzer of OCLC for providing the Dewey Decimal Classification and assistance during the project.

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