Social Tagging to Enhance Collaborative Learning

Elise Lavoué

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Élise Lavoué

Université de Lyon, CNRS
Université Jean Moulin Lyon 3, MAGELLAN, LIRIS, UMR5205
Elise.Lavoue@univ-lyon3.fr

Abstract. In this paper, we investigate how social tagging could be used in Education as a support for learning processes. We first summarize the results of recent works on the effect of the use of social tagging for knowledge building and learning. We show that few educational tag-based systems intentionally use tagging to enhance learning. We then describe a Tag-based Collaborative System (TaCS), meant for supporting social and collaborative learning thanks to tagging, and detail the learning processes expected by the use of the system. We conducted an exploratory study to observe (1) the evolution of the students' tags as an indicator of the learning of new concepts and (2) the evolution of the tags assigned to documents as an indicator of the learning of new conceptual relations. The results show that the students make their tags and their relations to documents evolve, mainly due to two activities: the comparison of individual and collective tag clouds and the negotiation for an agreement on a common tag cloud in the groups.

Keywords: Tagging systems, educational systems, collaborative learning.

1 Introduction

Social tagging is the activity of annotating and classifying digital resources with keywords (tags as metadata). It is used by most of web-based information systems for the collaborative indexing of massive amount of information [1]. However little is known about how Web 2.0 technologies, particularly social tagging, may directly interact with individuals at the knowledge and cognitive level [2]. In this paper, we are interested in the use of tagging in Education as a support for learning processes. Our research are based on some recent works [3, 4] described in section 2, which tend to explain how social tagging supports cognitive and social learning processes. We show that tag-based systems are mainly used in Education as a means of indexing and searching for information but that they are rarely used intentionally as a means of supporting collaborative learning processes. Section 3 is dedicated to the description of a Tag-based Collaborative System (TaCS) we have developed. This system is meant for supporting learning processes thanks to tagging. It helps learners to understand and be familiar with a domain of interest thanks to the tags they assign to their documents. We finally detail in section 4 the results of a pilot study conducted in real conditions during five weeks.

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2 Learning Processes and Tag-Based Educational Systems

2.1 Social Tagging and Cognitive Processes

Glahn, Specht and Koper suggest using tagging for educational issues, mainly for reflection activities [5]. Within the distributed cognition framework, Fu studies the interactions between the internal and external representations of concepts, tags and documents when a user is engaged in iterative explore-and-comprehend cycles [3]. The results suggest (1) that the interactions between internal concepts and external tags gradually lead to the sharing and assimilation of conceptual structures and (2) that social tagging systems are then a means for social exchange of knowledge structures. Based on these works, Kimmerle, Cress and Held [4] presents a model that defines learning and knowledge building as a co-evolution of cognitive and social systems while users tag. Their theoretical framework distinguishes four processes:

- *Externalization*: learners externalize their knowledge on a resource by assigning tags to it. To create tags, users have to articulate their own cognitive concepts and to translate them into keywords. This cognitive effort can arouse an individual learning.
- *Internalization*: by navigating in the information space using the tag clouds, users collect information relating to a tag. On the one hand, they learn tags used by the others and as a consequence how the others classify their resources. On the other hand, tags show new interconnections between concepts for users. It can lead to the incorporation of the concepts of the community and to the modification of the individual cognitive structures of users.
- *Assimilation*: by discovering and using new tags (and the associated concepts) that are in agreement with their knowledge, users can widen their knowledge but do not develop new different concepts.
- *Accommodation*: users can question and modify their cognitive concepts by learning that their associations on a specific domain are rather different, inadequate, or even false. It can occur when users realize that the other users use tags that are very different from theirs, what implies that specific resources or tags are bound to very different concepts.

2.2 Tag-Based Educational Systems

Social tagging systems are usually used to facilitate the collaborative indexation of massive quantity of information and to improve their access [6]. Connotea and CiteULike are examples of online reference management and social bookmarking services for assisting scientists, researchers and academics in storing, organizing, sharing and discovering links to academic scientific and research papers. Tag clouds are also used as an indexation and search tool by communities of teachers, as in the Cloudworks Web site [7], created for teachers to discuss their practices and ideas of educational design. The ASK - LOST 2.0 system [8] uses tags to index all types of digital educational resources (images, videos, texts, URL). Dahl & Vossen [9] apply social tagging to the context of e-learning repositories: the metadata repository share.loc and the content repository Learnr.

Some works are interested in tags for other educational applications. The social annotation and tagging systems OATS [10] and SparTag.us [11] allow highlighting a part of a text and tagging this content. For every annotated text, users can see their assigned tags as well as the most assigned tags by other users. It is also possible to see the cloud of the most used tags. However, these tools do not allow a collaborative work, since every student annotates and tags individually the text. The online collaborative system TACO [12], based on tags, has been developed to support language learning. This system is designed to improve the understanding of written English and more exactly to develop capacities of critical thinking. A forum is linked to each tag to allow learners to criticize them and to exchange ideas. This system is especially meant for helping teachers to assess precisely their students thanks to an automatic score mechanism applied on their tags.

In conclusion, usually only the community effect of tags (the use by a large number of users) is used for the indexation and the search for information. Only the TACO environment was really meant for collaborative learning, with negotiation and criticism of tags, but it is very specific to language learning. Our approach is not specific to a discipline and suggests using tags and tag clouds as negotiation and comparison objects within learning groups. We based on this approach to develop the TaCS platform described in the following section.

3 TaCS: A Tag-Based Collaborative System for Learning

In this part, we describe the Tag-based Collaborative System (TaCS) and the learning processes expected with its use. It is based on the content management system Joomla!. We have integrated existing components that we have modified and we have also developed a specific component to offer the functionalities described below.

3.1 Documents and Tags Management

Learners have a personal space in which they can create and manage documents and tags (see Fig. 1). A document is a text with its reference (the file or the link of the Web page where the text was extracted). Learners have to assign at least one tag that identifies the main concept or idea of their document. Tags are displayed under the shape of clouds. For each tag is indicated the number of times it has been used (the more the tags are used, the more the size and the font weight are big in the tag cloud). On the same interface, learners can see the tags currently used to describe documents (explicit information), the deleted tags (among those used to describe documents) and the tags used to navigate on the platform (implicit information).

TaCS is meant for collaborative activities, usually carried out by groups of four or five students. That explains why we distinguish three types of actors: the learner, the group and the class. Learners have access to their own documents and tag clouds from their space; to the documents and the tag clouds of their group from the group space; to the tag clouds of the class from the class space.

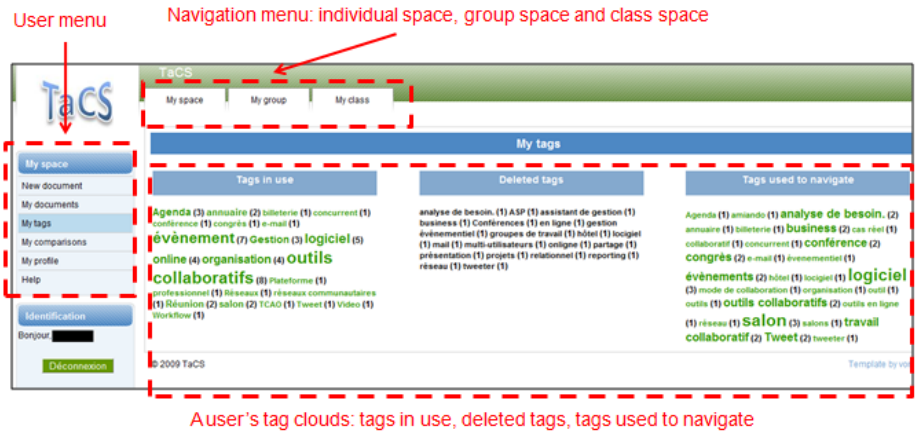

Fig. 1. Tag clouds of a student on TaCS (implicit and explicit information)

By asking learners to assign tags to documents, we expect them to think about the documents they create, to understand their content and to apply their ability to synthesize by identifying the keywords (tags) summarizing the main ideas and concepts. The difficulty of assigning tags to documents could bring learners to question the relevance of the document with regard to the domain studied. Furthermore, by giving learners the possibility to visualize their own tag clouds, we aim at bringing them to have a reflexive approach and to question their appreciation of the subject concerned. They can for example detect a gap between the approach they think to have and the image reflected by the tag cloud. The implicit information (deleted tags and tags used to navigate) also reflect for learners an image of their actions: they can realize for example that they often use a tag to navigate while they have never used it to describe a document.

3.2 Comparison of Tag Clouds and Statistics

The TaCS platform offers several functionalities to compare tags. From their own space, learners can compare their tag cloud with the tag cloud of their group (see Fig. 2). From the group space, learners can compare the tag cloud of their group with the tag cloud of the class (including the tags of all the groups). These comparisons concern the name and the degree of use of the tags. As explained in [3], a tag cloud can be considered as a simplified external representation of the internal concepts of learners or as a shared external knowledge structure of the group and the class. We think that the comparison of their own tags with those of their group or those of their group with those of the class could bring learners to assimilate new concepts and to question their own concepts. That could bring learners to create and/or delete documents and/or tags.

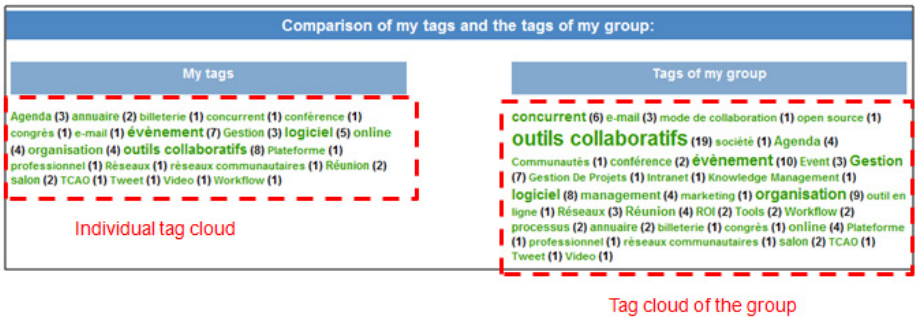

Fig. 2. Comparison of learners' individual and collective tag clouds

The system also displays some statistics:

- On the activity of the group: tags to define, number of used and deleted tags, number of created and deleted documents (for the group and for each member). These statistics give learners a means of situating themselves within their group.
- On the activity of the class: number of used and deleted tags, number of created and deleted documents by the class and by the group. These statistics give groups a means of situating themselves within the class.

3.3 Details on Documents and Tags

The distinction between documents and tags aims at bringing learners to realize that tags have as much importance as documents. Learners have access to the details of tags as well as the details of documents. The details are:

- For a tag: the learners that have used it, the associated documents and its definition. This definition can be created collaboratively by all the members of a group, thanks to the comment tool described in section 3.4.
- For a document: its editor, its title, its date of creation, its text, its references and the assigned tags.

We think that the visualization of explicit tag-document relations (tags assigned to document, documents associated with a tag by learners in a same group) could bring learners to discover and assimilate new conceptual relations and possibly to question and to modify their existing conceptual relations. That could lead to the creation of documents bound to a tag and/or to the association of new tags to a document.

3.4 A Community Space

TaCS offers community functionalities to bring conviviality and to favor the exchanges, the mutual aid and the negotiation between learners: a comment tool linked to each document and to each tag ; a voting system on documents and on comments ; a learner's profile ; a forum for each group (not accessible to the others), as well as for the class.

As explained in section 4.1, members of a same group are asked to build a set of documents and a model of indexation of the group (tag cloud). Learners of a group have to negotiate to reach agreement, especially to define a common definition of every tag. They also need to share their expertise on the domain, for example by means of forum, and to criticize and to evaluate the submissions of the other learners through comments and votes. By doing these activities, we would like learners to acquire and develop collaborative skills, such as to negotiate, to share and to criticize.

4 A Pilot Study of TaCS

We carried out an exploratory study, which attempted to gather evidence to support the usability and the utility of the TaCS platform as a support for the learning processes detailed in section 2.1. We also wanted to identify potential uses of the platform, maybe not previously meant. More precisely, we studied the effects of comparing tag clouds on students' activities and the effects of social tagging on the group dynamics.

4.1 Method - Experimental Data

This exploratory study was a part of a course about "Collaborative Information Systems" of a 5th year in University, from 11 November 2010 to 16 December 2010. The students had to study the case of a company, which organizes events abroad. They had to design a collaborative information system to facilitate the work of the employees of this company. The students were asked to search for documents on which they base their study, to tag them and to reach a common definition of every tag. They had access to the TaCS functionalities according to five phases so as to be able to observe the effect of the different functionality on the students' activities and to make hypothesis on the learning processes that occurred. We make it clearer that the expected learning processes were not exposed to the students, which means that they had access to the functionalities according to these phases but we did not ask them to use the functionalities with a specific intention. Each phase described below lasted a week:

- *Phase 1: Individual search for documents*. The students searched individually for interesting documents related to the case study and tagged them. Learners had access to their own space to create documents and to visualize their tag clouds.
- *Phase 2: Visualization of the tag cloud of the group*. The learners could compare their tag cloud with the tag cloud of their group. The aim was to bring students to modify their own tags or to create new documents.
- *Phase 3: Access to all the documents of the group*. The students had access to all the documents of their group, to the forum and to the list of the members of their group with their profile. They were able to discuss the documents and to vote for them thanks to the comment and vote functionalities. The aim was to bring learners to share all the documents within their group and to keep only those they estimated relevant to the case study.

- *Phase 4: Access to the statistics and the details of the tags of the group*. The statistics of the group were made accessible on its space (see section 3.3). Learners could also see for each tag the learners that had used it, the associated documents and its definition. This information aimed at giving learners a means of situating themselves within their group.
- *Phase 5: Visualization of the tag cloud and the statistics of the class*. The students had access to the tag cloud of the class to compare it with the one of their group and to the statistics of the class (see section 3.3). Each group could modify its documents and assigned tags.

This study was conducted with 17 students and the groups of learners were composed of 4 or 5 students. The results detailed come from two types of data:

- Use tracks: a specific tool was used to collect the use tracks according to the evaluation criteria (e.g. submitted and deleted documents; used and deleted tags at each phase).
- Questionnaire: this was filled anonymously to collect the learners' opinions and explanations regarding the used or unused functionalities and the learning processes they think they have applied. Among the 17 students, 13 filled in the questionnaire (47 questions).

4.2 Results and Interpretation

We observed a rather high level of participation on TaCS. 201 documents, 354 distinct tags and 969 tag-document relations (association of a tag with a document) were created. This participation can be explained in particular by the fact that the learners were globally satisfied by the ease of use (considered very good or good by 8 respondents and bad by 1) and the general quality of the interface (considered very good or good by 10 respondents, against 3 rather good).

Concerning the utility of documents, a considerable part of the created documents had been deleted at the end of the study (61 documents). We notice that almost all of the documents did not evolve after the first phase (by deletion or addition). At the first phase of individual work, the students created 180 documents among the 201 final documents. Furthermore, they deleted 57 documents during the first phase (among the 61 deleted documents during the study). So we can suppose that the fact of assigning tags to documents (aim of the first phase) brought the students to understand the proposed documents, to question them and to delete those they considered less relevant. We can also conclude that the collective activities and the comparison with the documents and tags of the other groups had no influence on the evolution of the documents.

We observe that the students revised their tags since 251 tags among the 354 distinct submitted tags were deleted at the end of the course. They also questioned the relations because at the end of the scenario 407 relations were deleted. According to the answers to the questionnaire, the learners made their tags evolve mainly for two reasons: after comparison with the tags of the members of their group and by a collective decision of the group. The answers to the questionnaire show that the comparison

of the learners' tags with those of their group mainly (1) allowed the students to have a view of the others' work, (2) led them to question themselves and (3) led them to make their tags evolve.

We studied the evolution of the distinct tags proposed by each group at each phase of the study, as an indicator of the evolution of the concepts identified by the learners as being relevant to the case study (see Fig. 3). We were also interested in the evolution of the tag-document relations, what can help us to determine if students questioned their conceptual relations:

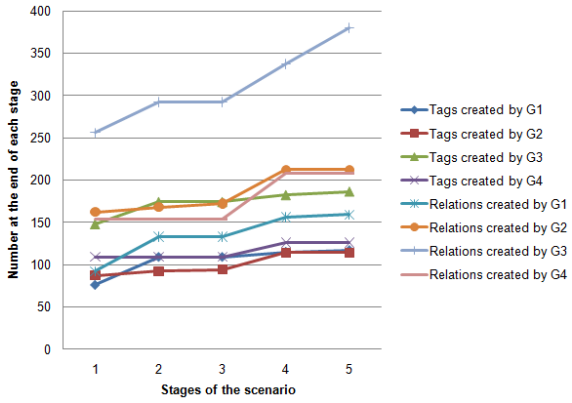

Fig. 3. Tags and tag-document relations created at each phase of the study

- The majority of the tags and relations were created during the first phase, what seems normal because it is the phase where the students created the documents and assigned their tags. This result confirms that the students tried to summarize their documents by tags from the first phase of individual work.
- A significant part of the tags and tag-document relations was created during the phase 2. It explains by the fact that the learners had access to the tags of the others, what confirms that the comparison had an influence on the creation of tags.
- The phase 3 had only a very low influence on the creation and the deletion of tags and their relations to documents. It leads us to conclude that the sharing of documents between students of a same group has an influence neither on the evolution of documents nor on those of their tags and relations to documents.
- Another significant part of the tags and their relations to documents were created during the phase 4. We also observe that most of the tags and tag-document relations have been deleted during the phase 4 (see Fig. 4). So during this phase the students not only deleted the tags and relations that they did not consider being relevant to the case study, they also created new tags and relations. We deduce that the negotiation within the group led students to question their tags and tag-document relations. These results also highlight the fact that most of the learners' motivation come from the dynamics inside the group. It is confirmed by the respondents who think that they have applied the expected collaborative skills: criti-

cism of the other members' submissions (documents and tags) (11 yes, 1 no and 1 NR); negotiation of tags (10 yes, 1 no and 2 NR), negotiation of the definition of tags (10 yes and 3 no) and documents (11 yes, 1 no and 1 NR).

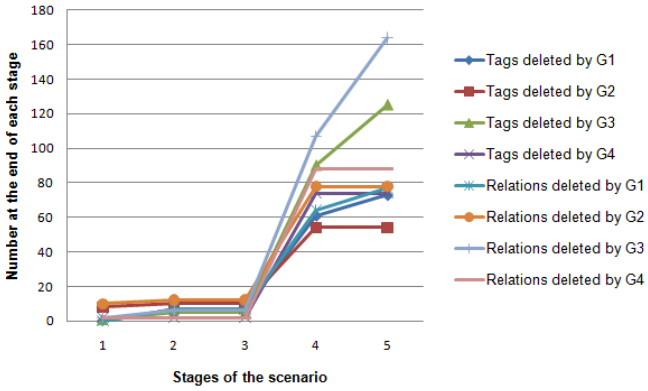

Fig. 4. Tags and tag-document relations deleted at each phase of the study

- The low evolution of tags and tag-document relations during the phase 5 leads us to think that the comparison of the tags of a group with the tags of the whole class has only little influence on the evolution of tags. We can also observe that students are especially interested in the work within their group and that they do not compare much themselves with the other groups. This is an interesting result that can question the need of a space for the class.

5 Conclusion and Future Work

With this study, we observed that the sharing of documents between the students of a same group has an influence neither on the evolution of documents nor on those of their tags and relations to documents. Regarding the expected learning processes, we notice that the students effectively questioned their tags (more than documents), mainly due to a comparison with those of the other members of their group. The criticism and the negotiation within the groups also seem to provoke a questioning and a modification of tags and documents. We thus suggest that tags could be more used on educational web-based systems, so as to support learning processes such as synthesis of the main ideas and concepts of a text; students' reflection on their own internal concepts; assimilation of new concepts; and creation of new conceptual relations. We advance that tags and tag clouds can be used within groups of students as negotiation and comparison objects to enhance the learning of new concepts and conceptual relations within collaborative activities.

This work opens up several possibilities. The first one is to analyze in detail the relevance of the tags assigned to documents and their evolution at each phase of the scenario, according to the offered functionalities. We are comparing the tags created by students with keywords extracted automatically from the text of documents (with

text-mining tools). This analysis will allow us to finely study the utility of the functionalities of the TaCS platform. From a long-term perspective, we think that tags could also be used to help teachers to monitor learning activities and to evaluate students (individually and collectively). Tag clouds are indicators which could reflect the learners' acquisition of the concepts of a domain and the learning processes they applied. Tags could also be used to collect metadata on learners to be able to personalize their learning activities.

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