# Reflection Support Using Multi-encoded Tag-clouds

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**Abstract.** This paper reports on a qualitative study about the application of tag clouds for supporting meta-cognition in self-directed and incidental learning. It analyses the use of a personal tag-cloud visualization of the tags that are used at a public social bookmarking service. The study focuses at the types of meta-cognitive control based on reflection notes of the learners. These notes were analyzed regarding the contents of the reflections as well as regarding their meta-cognitive type. The study has two important outcomes. Firstly, a personal tag cloud can stimulate reflection on the tagging activity of a learner. Secondly, reflecting on the tagging activity is not built into the design of a tag cloud.

**Keywords:** tagging, visualization, evaluation, reflection, self-directed learning, incidental learning

## 1 Introduction

This paper focuses on tag clouds that are based on the personal tagging information of a learner. For supporting self-directed and incidental learning tag clouds hold some potential to stimulate reflection on concepts and learning processes, even though such visualisations do not show valid information in terms of approved domain knowledge. A tag cloud can stimulate reflection because the visible tags are meaningful to the learner and allow associations to the actual learning experiences. This paper reports on a qualitative study about using tagging visualisations to stimulate reflection about self-directed or incidental learning activities. This article analyses if the visualisation of a learner's tagging activity in the form of a tag cloud can stimulate meta-cognition of self-organised learners. The present study analyses the types of reflection that are stimulated by a personal tag cloud that is based on a mash-up of different information that is provided by the social bookmarking service delicious.com [3].

## 2 Background

Tagging stands for applying free form keywords (the tags) to resources that result in user-generated metadata. Tagging is closely related to the developments in the context of the Web2.0 [19]. A number of scientific contributions focus on tagging as a type of

user and community driven creation of meta-data [10, 11], or used tags to improve the accessibility of contents [12, 19]. A number of commercial Web2.0 services supports tagging, because freeform tags provide an easy and flexible way for organizing content and information.

Prior research [2] has argued that labelling and tagging supports meta-cognitive processes in self-regulated learning. Several studies [1, 2, 18] analyzed visualizations of conceptual structures for supporting self-regulated learning in pre-structured knowledge domains. Therefore, the designs of the visualizations were guided by the external learning objectives of the related formal educational context. In these settings the learners could not extend the tagging vocabulary or the conceptual structures.

In contrast to formal education, self-directed learning is defined by a high degree of learner control in weakly structured knowledge domains [16]. This idea of learner control is already incorporated with many Web2.0 services that enable their users to create personal concept structures through tagging rather than replicating predefined concept structures [21]. This has inspired the development of personal learning environments [24].

The concept structures in personal learning environments vary for each user and can range from a few tags to a couple of hundreds. This freedom for the learners requires that visualizations are independently designed from conceptual structures or knowledge domains. Related approaches [4, 13] visualize learner actions that were monitored by the supporting system – the "interaction footprints" [23].

**Table 1.** Relations between dimensions and factors of situated learning

| Lave, 1993 → <br> Wenger, 1998 ↓ | Process | Peers | Event | Partici-pation | Concept | World |
|---|---|---|---|---|---|---|
| Presence | | X | X | X | | |
| Rhythm | X | | X | | | |
| Interaction | | X | | X | | |
| Involvement | | | | X | | |
| Value | | X | | | X | X |
| Connections | | X | | | X | X |
| Personal Identity | | | | X | | |
| Communal Identity | | X | | X | | |
| Relations | | X | | | | |
| Boundaries | | X | | X | | X |
| Integration | X | X | | | | |
| Community building | X | X | | X | | |

The present paper analyses if tag clouds can stimulate and support reflection in self-directed and incidental learning, which depends on the ability to reflect on actions [5, 20]. Three variations of reflection were identified to be relevant for learning: reflection *on* action, reflection *in* action, and reflection *for* action. The main difference of these reflection types is the occurrence of the reflection. Ertmer & Newby [5] define reflection as an activity that links *meta-cognitive knowledge* and *meta-*

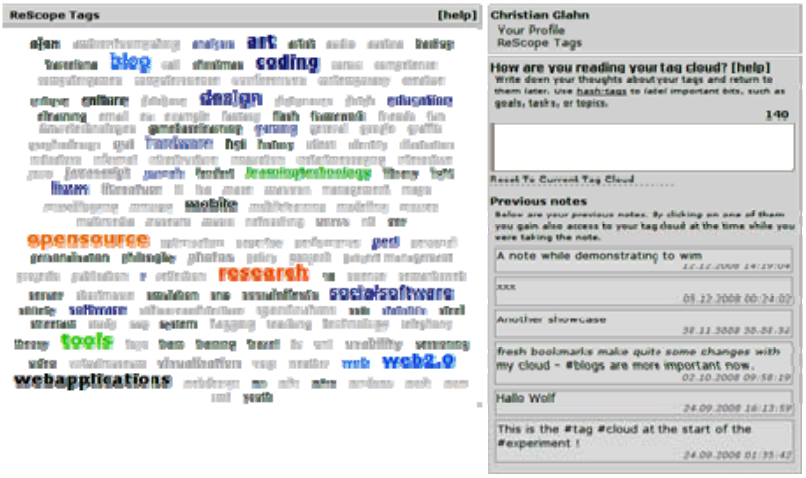
*cognitive control* (self-regulation). The related reflective processes can be clustered into three stages: *planning*, *monitoring*, and *evaluating*.

Lave & Wenger [15] introduced the concept of *situated learning*. This concept reflects the social dimension of learning. From this perspective learning cannot be reduced to a set of learning *events*, but requires tight coupling to the related social practices. Further studies highlighted several dimensions and factors of contextualization in learning [16] and contextual support for learning [22]. Table 1 shows the relation between these dimensions and factors. This relation allows identifying, which types of interpretations of the learning processes can be expected for a context dimension. This study focuses at the level of *process* and *concept* as the primary context dimensions.

## 3 ReScope

The present study uses the ReScope system [9]. ReScope is a web-based mash-up for fetching, aggregating, and visualising tagging activities in the social bookmarking service delicious.com [3] and allows learners to annotate and to track their tagging activities. ReScope has provides two tools: a tag cloud visualisation and a tag cloud annotation tool. The ReScope tag cloud provides different perspectives on tagging by combining and contrasting different aspects of tag usage through colour codes and font sizes. With tag cloud annotation learners can track their tag clouds over time: as soon as an annotation is submitted, a snapshot of the current tag cloud is attached to it. When a user clicks at an older annotation, the attached tag cloud is loaded and displayed to the learner. Figure 1 shows an example of the ReScope user interface.

**Fig. 1.** Screenshot of the ReScope user-interface



The design of the ReScope tag cloud is based on the contextual dimensions *concept* and *process* of the contextualization dimensions of situated learning.

1. Concepts: The overall tag usage of each tag is indicated by its font-size.
2. Process: The most recent usage of tags is indicated through color codes.

Because this information is entirely based on the tags that are used by a learner, it is expected that it can serve as an anchor for reflecting about the personal tagging habits and the related knowledge structures.

## 4 Research objectives and questions

This study has two main objectives: (a) identify if and how tag clouds can stimulate meta-cognition of learners regarding their self-directed and incidental learning on the Web2.0; and (b) identify design factors for the underlying use case for reflection support. Within this scope this study addresses the following questions.

- Does the ReScope tag cloud stimulate meta-cognitive activity?
- Does the reflection on the tag cloud confirm contextual factors suggested by the contextual framework for situated learning?

According to the relations of contextual dimensions and factors, it is expected that the notes can be linked to the context factors *rhythm*, *value*, and *connection*. Rhythm refers to all types of structuring a process. Value covers anything that is related to the added value of concepts and conceptual structures for the learner. The factor connection refers to the structure of the concepts as well as the relation of concepts to resources. The factors “integration” and “community building” are not expected to occur, because ReScope does not visualize connections between peers.

## 5 Method

The participants were invited through promoted on several mailing lists, web-logs, web-sites of related research projects, and on two European conferences in the domain of computer assisted learning. The participation was entirely voluntarily. The interface of the ReScope system included information texts that asked the participants to write down their thoughts about their reception of the tag cloud in the notes field and to label important words with a hash ('#'). This technique is also known as hash tagging.

Nine weeks after the initial announcement of the system the system's usage has been analyzed. “Noisy” statements like as “hello” or “xxx” were removed prior to the analysis. The remaining notes were labeled with the three types of meta-cognitive control of Ertmer & Newby [5]: evaluate, plan, and monitor. Additionally to this model based labeling, all notes were clustered based on the contained information using content based labeling based regarding the context factors of situated learning.

## 6 Results

Over the period of nine weeks, 76 users have registered with ReScope. According to the domains of the registered e-mail addresses, participants from 13 countries were identified. In average, the respondents were 36 years old; the youngest participant was 22 and the oldest was 58 years old. The majority looks at the official tag cloud at delicious.com (91%), although 73.5% of the respondents state that they look at their tag cloud only sometimes or rarely. Nine participants left 43 notes about their tag cloud. After cleaning the noise from the notes, 35 notes remained that describe reflective activity of their authors.

The first notes of five users reflect their surprise over the structure of their personal tag cloud and expressed the need to adjust the tags. An example for these notes is given by User A.

"I have too many occurrences of singleton tags #clean-up".

The note of User A also shows the use of a hash tag. This feature has been used by six participants in 14 notes. The provided hash tags were beneficial for labeling the notes for the analysis. The following two examples illustrate the use of hash tags. In the first note, User F stated.

*"need to cut out #duplicate_tags"*

A more complex example of hash tags is given by the statement of User D.

*"Writing on my #blog (++space) I realised I hadn't used #tag podcast very consistently. #consistency important, so I #edited the post."*

All messages were labeled according the three types of reflection for meta-cognitive control: evaluate, plan, and monitor. One note was labeled with evaluation and planning because the note stated first the result of a self-evaluation and then defined an objective for future tagging. 17 notes are labeled as evaluative reflection, six notes as planning, and 13 notes as monitoring.

The results from the model centric labeling show that all three types of reflections were identified with the notes (see Table 2). The majority of the notes were labeled as evaluative reflection. A fifth of all notes and two fifths of those that were tagged as evaluative reflection referred to cleaning the tagging structure.

Additionally a content based labeling has done on all annotations. After this procedure a note could have many labels assigned. This step brought up three key categories: 23 notes were reflections about the semantic structure of the tag cloud, six notes were reflections on organizing the tagging process or on aligning it with other tasks, and nine notes were reflections on system features. Furthermore, two notes were labeled as reflections on social interaction and one note was labeled as a personal remark. Four notes were classified as follow-ups to prior notes that marked steps in a process. Within the notes on the semantic structure, three sub-categories were identified. The participants reflected in seven notes on the need of cleaning up the tag structure, in eight notes about the consistency of how the tags are used, in two notes about emerging tags.

## 7 Discussion

The present study focused on the potential of tag clouds for supporting reflection on the personal tagging of self-directed learners. It combines and extends the prior research on visualizations of learner activity based on knowledge domain independent information [6, 7] as well as the research on using tags for identifying learner interests in open ended environments [8, 9].

The results show that already the rather simple visualization stimulate reflection are conforming the models of meta-cognitive control. The notes of the content based labeling are equally distributed across all types of reflection (Table 2). This suggests that the tag cloud supports meta-cognitive processes in self-directed learning of all levels similarly. Based on the present results it can be argued that tag cloud visualizations can serve as a reflection support tool for self-directed learners.

**Table 2.** Results of model and contend based labeling

| | *feature* | *process related* | *semantic structure* | *consistency* | *clean-up* | *emerging topics* | *general reasoning* |
|---|---|---|---|---|---|---|---|
| *evaluate* | 4 | 3 | 5 | 3 | 4 | 0 | 3 |
| *plan* | 2 | 2 | 3 | 3 | 2 | 0 | 0 |
| *monitor* | 1 | 2 | 6 | 3 | 1 | 2 | 0 |

The results of the content labeling can be interpreted as instances of the context factors for situated learning. By mapping the identified labels on the context factors, it becomes possible to address the second research question. The design of the tag cloud focused at the context dimensions *process* and *concept*. Therefore, it is expected that the participants' notes are related to the context factors *rhythm*, *value*, and *connection* (Table 1). Notes that were labeled only as *semantic structure* but not to any of the sub-categories were mapped to the connection factor, because these notes reflect the relations between the tags and the relations between tags and resources. Notes of the categories *process related* and *emerging topics* were mapped to the rhythm factor.

**Table 3.** Relations of labeling after remapping content lables to context factors

| | *rhythm* | *value* | *connection* |
|---|---|---|---|
| *evaluate* | 3 | 7 | 5 |
| *plan* | 2 | 5 | 3 |
| *monitor* | 4 | 3 | 6 |
| ***Total*** | **9** | **15** | **14** |

Finally, the notes of the categories *clean-up* and *consistency* were mapped to the value factor, because these notes refer to the value of the tags for the personal information management. Table 3 shows the results after remapping of the contextual

factors. The results show that the reflections related to the three factors were almost equally stimulated by the tag cloud. This finding supports the expectations regarding the relevance of the contextual factors for reflection.

## 8 Conclusions

Reflection is the active reasoning that has been described as the learner's assessment and validation of experiences in problem solving and social interaction against conceptual structures and strategies. This process is part of developing consciousness about the relations between actions, beliefs, and concepts. Therefore, reflection is an important meta-cognitive process related to learning. This article analyzed if a tag cloud visualization of a learner's free form tags can stimulate such meta-cognitive processes. This study has two important results.

1. A personal tag cloud can stimulate reflection on the tagging activity of a learner.
2. The concepts of situated learning can be applied for developing tools for supporting self-directed learners.

The findings of this study indicate that targeted solutions for supporting meta-cognition do not need to be dependent on pre-structured domain knowledge. This opens opportunities for developing new forms of supporting self-directed and incidental learning in personal learning environments.

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