# Implications of writing, reading, and tagging on the web for reflection support in informal learning

Christian Glahn[1], Marcus Specht[1], Rob Koper[1]

[1]OTEC, Open University of the Netherlands, Valkenburger Weg 177, 6419AT Heerlen, The Netherlands
{christian.glahn, marcus.specht, rob.koper}@ou.nl

**Abstract** The use of tags as user generated meta-data as well as the visualisation in tag clouds has recently received a lot of attention in research and practice. This paper focuses on supporting reflection of learners by using different presentation approaches of user-generated meta-data for reflection support. Previous research has shown that implicit interest expression can be a valuable source for reflection support. Visualising implicit or "tacit" interest in tag clouds could help learners to understand the connections of their content related activities to the tags that are assigned to the content. For grounding this potential in the social practice of using tags in teams and small communities, we conducted a three month experiment. This experiment focused on the social practices of using tags explicitly and implicitly. In this paper we analyse the data of the experiment with regard to social navigation of teams and small communities, relations of implicit and explicit interest in tags, and usages of tags on different participation levels. The findings on these dimensions of the social practice of using and sharing tags in groups help to develop a better view on the requirements of providing reflection support.

**Keywords** informal learning, learning communities, social software, web2.0, evaluation

## Introduction

The use of tags as user generated meta-data has recently received a lot of attention in research and practice. A large number of scientific contributions focus on community driven creation of meta-data [10, 11], or on improved accessibility of contents through this kind of meta-data [12, 18]. So far, only few publications have focussed on the relations between the explicit usage of tags and their implicit usage in search queries and while accessing information [7, 16]. Particularly, contributions on applying tags in the educational domain basically address the value of tags for improving access to relevant content. From an educational perspective this covers only a limited part of learning processes, because these processes include – among others – reflection activities. Reflection is a fundamental learning activity and is needed to articulate, express, and apply knowledge appropriately [21].

In this paper we address the need of supporting reflection of learners in open environments by applying different presentations of user generated meta-data. A

common example of such presentation is a “tag cloud”, in which the tags are not only listed, but the usage of a tag is shown in its display size. I.e. tags are larger size if they are more frequently used than other tags (see Fig. 1). The frequency of a tag is therefore *encoded* in its display size.

We propose that different forms of information encoding in tag clouds can stimulate and support reflection on learning processes that are embedded in other activities. Previously, we outlined how this can be achieved [8, 9]. Furthermore, we deduced from insights in self-regulated learning [2] that reflection support might be dependent to the context in which learners are active. However, these approaches of reflection support are to this stage conceptual outlines, which require a better understanding of the social practice of the contexts in which tags are applied.

This study analyzes the differences between the explicit use of tags for bookmarking or blogging in comparison with their implicit use when reading tagged contributions. In this paper we report on our findings from a three month experimental pilot and answer the question if explicit and implicit interest expression hold different information that is potentially meaningful for learners.

## Background

One aspect of supporting reflection through tag clouds is that the information encoding helps to visualize relations between different information types. Given our goal to help users in recognising their tacit knowledge, the interest in tags must not be restricted to the explicit use of tags, but has to take the implicit tag usage into account. So far only limited research has reported on “implicit interest expressions” [3] and the relations of interest and social practices in online communities.


**Fig. 1** team.sPace tag cloud (detail view)

We approach this gap and analyze implicit and explicit tag usage of a group of users who were using the team.sPace environment [8]. team.sPace is a web-based community portal that allows its users to share bookmarks and blog entries. Figure 2

shows a typical view of the team.sPace web-site from a user's perspective. The information presented in team.sPace portal is entirely based on peer contributions. The portal aims basically at information exchange and aggregation. Learning is not an explicit goal for using this environment. Therefore, the underlying system is not based on an explicit instructional or learning design. To this extend team.sPace shares attributes with other social networking platforms and community portals, in which users learn incidentally, too.

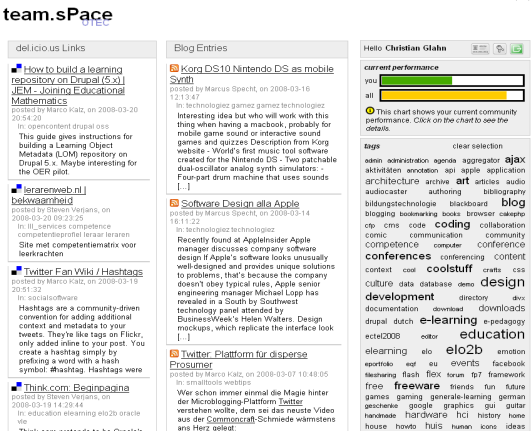


**Fig. 2** user perspective of team.sPace

## Question for research

For supporting reflection in informal learning scenarios, we are interested in learning processes related to knowledge creation and knowledge exchange in teams or small communities. For this purpose we studied how the user's interest can be deduced from different user activities. As noted already by Claypool et al. [3] explicit and implicit references to a user's interests have to be distinguished. Implicit and explicit references are related to different types of user actions. Claypool et al. [3] have focused at understanding which user activities are relevant for deducing a user's interest. However, it has not been investigated how different user activities are related to interest expressions of a user.

Explicit interest expressions are all actions that are directly related to a user's interest and provide evidence of interest, such as user ratings, bookmarked URLs, user applied tags, or if a user writes a web-log entry about a topic. Implicit interest expressions typically do not provide direct evidence about a user's interest. Examples for implicit interest expressions are: click-troughs to a resource, the time a user spends viewing a resource, or tag selections in a tag cloud.

Understanding how tags are used is a prerequisite for raising the learners' attention on their learning interests. Therefore, our research seeks to answer the question, if a user's implicit expressions of interest in tags provide different information about a learner's interests than explicit interest expressions.

## Related Research

Situated learning as introduced by Lave and Wenger [14] highlights the importance of competence development in a social context and the integration in a community of practice. Lave [15] states that from the perspective of situated learning, learning processes can't be seen as processes of knowledge acquisition that result in "possessing" knowledge. Instead, the concept of situated learning refers to learning as ongoing social practice, which is not defined by planned structures of curricula, rather than by the social practices, tasks, situations. Hence, learning is not context free, but *situated* in social contexts and social practices. As a consequence, knowledge and competences cannot be considered independent from the contexts and processes, in which they are developed and applied. From this perspective, learner support has to be seen as empowerment of learners, rather than overcoming their deficits [15].

This view is closely related to concepts of self-regulated learning processes, for which Butler & Winne [2] developed a model. In this model the actions of learners are interlinked with the responses learners receive on these actions from their environment. However, for designing technical support for self-organized learners this model is limited, because it models the "environment" as a "black box". In order to overcome this limitation from the perspective of technological development, we suggested earlier [8, 9] to extend this model by including principles of context aware systems [4, 5, 22, 23] on the environmental side of the model. This integration links the work on self-regulated learning with the achievements in the area of interactive and ubiquitous systems. The resulting *learning interaction cycle* is a feed forward system, in which the actions triggered by the cognitive system and the responses of the technical system affect each other. This means that both sides are not only respond the based on the actual input, but also incorporate the interaction history into their responses on the input actions. The underlying implication of this model is that technological support for self-regulated learning has to be adaptive with respect to contextual parameters of the learning activities.

Based on this theoretical model, we proposed a four-level system architecture [8]. At the lower levels this architecture is closely related to the works in the area of attention meta-data [19], whereas on the higher levels the architecture our work is related to user adaptive systems [1] and to social awareness [6, 13]. The purpose of the architecture is to provide an integrated approach for stimulating and supporting situated learning, that does not only reflect the temporal needs of learners but also allows adapting to the changing context of the learners.

Given this perspective on learning it is reasonable that reflection support should also follow the principles of the learning interaction cycle. Therefore, we assume that user-generated meta-data helps to identify explicit and implicit interests of users, which can be used to stimulate reflection on their personal learning processes. Our research has similarities to utilizing information about explicit and implicit interest of users to support their interaction with online information systems [3]; and with link sharing and social navigation [16].

Claypool et al. [3] compared implicit with explicit interest expressions in web-based content. The goal of their research was to identify if implicit expression of interest in content can be used as alternative to explicit rating of content. The authors distinguish between explicit expressions of interest, such as rating content, and

implicit expressions of interest like reading content or bookmarking content. In a pilot study different kinds of user interactions have been analysed regarding their relation to a user's interest in contents. The authors identified that not all "promising" types of interactions can be used to infer the users' interest about a resource. The findings of this study were largely confirmed by a study in the educational domain [7]. Although our research also focuses on user interest, it differs from this previous research in two ways. First, Claypool et al. [3] and Farzan and Brusilovsky [7] analysed the user interests relative to single resources, while we are addressing interests regarding tags and concepts that are shared between resources. Second, the previous research was addressed only the users' interests in resources, while we analyse the conceptual differences of implicit and explicit interest on topics that are represented by tags.

Millen and Feinberg [16] have analysed the social dimension of sharing and browsing resources on the worldwide web in an organisational context. The authors were interested, if providing social bookmarking within an organisation leads to social exchange across the organisation, or if it leads to accumulation of information, with little relevance for other users in the organisation. The related field experiment was using the "dogear"-environment [17] showed that social bookmarking stimulates social exchange of information in a relatively large organisation [16]. In a way, our research takes up these findings and investigates if they can be extended to teams or smaller organisational structures as well. Additionally, we emphasize qualitative aspects of the social exchange that has been observed by Millen and Feinberg, as we focus on the developments of different kinds of interests that were developed through the general social practice regarding the content.

The studies of Claypool et al. [3] and of Millen and Feinberg [16] do not provide any implications on context dependency of their findings, because in both cases the experimental groups as well as their behaviour were treated as homogeneous. Both studies have not addressed contextual variables that might possibly affect the interest of the individual users. Hence, it is not reasonable to assume that the expression of interests is context dependent per sé.

In short, in this section we identified three gaps in research: firstly, research on implicit interest expressions has been focused on single resources, but not on tags that are used with several resources; secondly, social navigation was analysed in large user communities regarding the potential of this general concept of social activity for stimulating social exchange, but not regarding its application in teams or small communities and regarding its benefit for the individual participants; finally, user-generated metadata and social navigation have been only analysed from the perspective of homogeneous groups, but not as practices that are possibly connected to context.

## Hypothesis

Based on these gaps in research and our research question, we define four hypotheses, to which regard we analysed the data of our experiment. The initial hypothesis of our experiment was as follows.

*H1. team.sPace can support teams and small communities for social navigation.*

This hypothesis implies that the users of the experimental system make use of the resources that were provided by others and that social navigation takes also place in teams or small and local communities. The underlying assumption is that the findings on social navigation of large groups and communities are also applicable in smaller groups or communities.

*H2. Implicit interest expressions of the team.sPace users do not replicate the community's aggregated explicit interest that is represented in the tag cloud of the system.*

This hypothesis directly addresses our main question for research. It has the important implication that the users' implicit interest is not biased by the tag cloud of the system. This hypothesis verifies our initial assumption that the use of tags in reading and searching is not biased by visualisation of the community's tag cloud. Additionally, we defined two hypothesises subordinate to H2.

*H3. The implicit interest expressions of contributing users are more focused in certain tags than the interest expressions of non-contributing users.*

This hypothesis refers to varying interaction patterns for users at different participation levels. We assume that non-contributing users tend to explore the different topics more than contributing users. Therefore, we expect a wider distribution of tags for non-contributing users than for contributing users.

*H4. Users who contribute more to social bookmarking or blogs are more likely to replicate the tags they use for their own contributions also in their implicit interest expressions.*

This final hypothesis addresses the differences of perceiving tags among the groups of users. We assume that users who actively contribute in blogs and social bookmarking are more aware about their interests and therefore are more focused in their reading habits than users who are less active. This hypothesis implies that the users' tagging habits on one side and their reading and searching habits on the other side are not independent from each other.

## Method

For analysing the previously defined hypotheses we conducted a three month experiment using the team.sPace environment. team.sPace is a web-based community portal that allows its users to share del.icio.us bookmarks and their personal blogs among a group of users. The portal has three main sections: the first part contains a feed to social bookmarks, the second part contains the aggregated blog information, and the third part contains user and navigation tools, such as a tag cloud that can be used for information filtering. The team.sPace tag cloud does not contain all tags, but only those tags that were used at least by two users or used by a single user more than five times. The information provided in each part of the portal, is aggregated from all users of a group, who have registered sources to the information of the sections. While indexing the contributions, team.sPace excludes all contributions that were not tagged. This step assures that all contributions in the portal have tags assigned.

The experiment was conducted with members of a research department at the Open University of the Netherlands. The participants were invited according to the similarity of their research topics, while these persons were previously not collaborating intensively in the same projects. The invited participants could register themselves with team.sPace and configure team.sPace so the portal can integrate their contributions into a community feed. The participants could freely choose if and which information they contribute to this small community. Given to the types of resources this creates four groups of users: Fully contributing users who contribute blogs and bookmarks, blogging users who contribute only blog entries, del.icio.us users who contribute only bookmarks), and reading users who do not contribute at all. Within team.sPace the users can perform three different types of activities: contributing, reading, and exploring. Because all contributions in team.sPace have tags assigned, all user actions are automatically associated to tags. For the experiment only the user actions were tracked, but no feedback on the users' interests was provided.

team.sPace traces the users' explicit interests through the tags they assign to their bookmarks and web-log entries. Implicit interest is traced on conceptual browsing while users click on tags in the tag cloud; and by tracking the users' accesses of the contributions. After the experiment we analysed the explicit and implicit use of the tags which were available in team.sPace. In order to verify our hypotheses, we analysed the data in four steps.

In a first step we analysed the social navigation of the users by comparing the number of explicit and implicit tags that were used by a user. Explicitly used tags are only assigned to the contributions of a user, while implicitly used tags could have been also assigned to contributions of other users. By removing all tags from the list of implicitly used tags if they were used by a user in both ways, only those tags that were assigned to the contents of other users remain in the list. A larger number of individual tags in this list imply that a participant utilised social navigation more actively.

The second step should verify that a user's implicit interest does not simply replicate the community's explicit interest. In order to do so, we needed to show that the users did not simply use tags that were highlighted in the tag cloud. To prove that this does not only replicate the user's conscious concepts, we ranked the most relevant tags for explicit and implicit interest expressions. Both rankings were calculated for the community as well as for each user. We calculated the overlap of the 30 most relevant tags of the users' implicit interest expressions with the top 30 of the ranking of the group's tag cloud. This procedure has been repeated for the overlap of the implicit and the explicit interest expressions. A lower degree of overlap in both runs proves that the implicit interest expressions in social navigation hold potential to unveil tacit knowledge and concepts.

At the third step we analysed if the implicit interest expressions of non-contributing users are more random than those of contributing users. For this purpose we reused the relevant tags that were identified during the second step. For each user we calculated the average frequency of using one of the relevant tags and the standard deviation of this average. A lower average frequency and a low deviation mean that the tags were used more randomly by a user. In this case the user did not select the tags very often, and all values are lying in a narrow interval, whereas a focus on some

tags would have been selected more often than others, which results in a higher deviation and average. We calculated the randomness of implicit interest expressions for contributing and non-contributing users.

Finally, we analysed if active users are more focused in their reading behaviour and align their implicit and their explicit interest expressions. A quick impression if the distribution is gained by calculating the overall usage of the tags that were used only implicitly, and those implicit interest expressions that were also explicitly used. In order to compare the results across the users, we represented the values relative to the total amount of implicit tags that were used by the user. As a result, a higher percentage of tags that were use only in implicit interest expressions means that the user was less aligned with the explicit interests. Of course, this relation is only meaningful for contributing participants, because by definition non-contributing participants don't express their interests explicitly.

## Results

We invited 30 people to volunteer in the experiment. Of the invited group, twelve registered and participated in the experiment. Four participants registered their web-log feeds, nine registered their del.icio.us nicks, and three participants were only reading. All users who registered their web-log also registered their del.ico.us account. During the period of the experiment, the portal has been visited 926 times by these users. They followed 331 times a link to a contribution and selected 389 times a tag in the tag cloud. 1411 contributions were registered, of which were 1303 bookmarks and 108 were blog entries.

847 individual tags were assigned 3068 times to the contributions. In average a contribution has 2.2 tags assigned. 326 tags or 39.7% of the tags can be considered as relevant to the community, as these tags have been used more than twice in the lifetime of the experiment, either as explicitly assigned to a contribution, or implicitly while accessing an article or while using the tag cloud. The minimal threshold of three usages per tag assures that a tag was not used once and has then been read or selected incidentally. The relevant tags were assigned 2431 times to contributions and cover 79.2% of the overall explicit tag usage.

365 individual tags were assigned to contributions that were read by the participants, and 133 unique tags were accessed through the tag cloud. The average contribution that has been read by the participants had 3.7 tags assigned. 232 tags were assigned by at least two participants to their contributions. The majority of these tags are shared among less than four participants (78%). Another 30 tags were assigned more than five times by a single participant. The tag cloud in team.sPace displayed therefore 262 tags at the end of the experiment. 159 tags were read, and 97 were accessed through the tag cloud by at least two participants. 43 tags were accessed by different participants while reading and searching.

Among the relevant tags within team.sPace we identified several concept clusters. These clusters contain tags that reflect semantic similarities. An example for such a cluster is learning, which is reflected by the tags: "bildungstechnologie", "e-learning", "elearning", "e-leren", "e-pedagogy", "educationaltechnology", "learning_techno-

logy", "learningtechnology". The tags in these clusters were accessed very differently. However, a detailed analysis of these tag clusters is beyond the scope of this study.

The range and variety of this data set allows us to run the analytical steps, which have been defined in the previous section, and draw first conclusions with regard to our hypotheses.

Out of all tags the contributing participants in 36,6% of the cases used a tag more than once in their implicit interest expressions (n=8; σ=16.5%). This result takes all tags into account. With regard to the tags that were relevant to the group, 55.5% (n=8; σ=23.4%) of the tags assigned to a participant's contribution were also used in implicit interest expressions.

The 30 most frequently used tags in the participants' implicit interest expressions overlapped with the most relevant tags of the shared tag cloud in average to 40.4% (n=11; σ=11.4%). The implicit interest expressions of the non-contributing participants overlapped the communities interests to a lower extend (34.4%; n=3; σ=12.62%) than the interest expressions of the contributing participants (42.6%; n= 8; σ=10.9%). We repeated this step with the ten most frequently used tags of each participant. The average overlap of implicit interest expressions and the tag cloud was for non-contributing participants 20.0% (n=3; σ=20%), and 48.3% (n=8; σ=12.9) for contributors.

The average implicit interest of contributing participants in these tags has been expressed by 2.5 requests (n=8; σ=1.7), the average range of interest was 2 tags (n=8; σ=1.6). Compared to these results, the non-contributing participants expressed their implicit interest in average by accessing 1.6 tags (n=3; σ=0.81) with a range of 1.2 tags (n=3; σ=1.39).

With regard to the focus of interest of the participants we found that in average 52.8% of the tags were used only in implicit interest expressions (n=8; σ=19.6%). With regard to the participation to the group, we compared more active participants with those who were less active. We set the threshold for that defines more active participation to a minimum of 100 tags in implicit interest expressions. This threshold created two sub-groups of each four participants. With regard to their focus of interest, the more active participants were more interested in tags, which they did not use themselves (56.8%; n=4; σ=10.6%). In comparison, less active participants were less focused on the tags, which they did not use themselves (48.9%; n=4; σ=27.2%).

## Discussion

Our data confirmed hypothesis H1, that team.sPace supports social navigation in teams and small groups. The low ratio of overall repetition of explicitly used tags in implicit interest expressions (36.6%) indicates that the participants were interested in the contributions provided by the other participants. As for each contribution a short description is provided in the portal, the participants are more likely to access information in which they are interested. It is not surprising that more relevant tags appeared more often (55.5%) in implicit and explicit interest expressions, as these tags were shared among the participants. These results show that explicitly used tags are not only used to structure the own contributions, but are also relevant for

exploring other content that is relevant to the participants' interests. Thus, principles of social navigation also appear to apply to smaller groups.

Hypothesis H2 was supported by the experimental data. We analysed the overlap of the most frequently used tags in the participants' implicit interest expression with the most relevant tags of the team.sPace community. The relatively low overlap of the participants' implicit interest expressions with the tags presented in the shared tag cloud indicates that the tag cloud affects the actual reading habits to a limited extend. This was particularly the case for non-contributing participants. However, we identified in the ranking of implicit interest expression that all participants partially referred to semantically similar tags. This effect can be explained with the low sharing rate of tags, because the majority (78%) of shared tags have been shared by two or three participants. Therefore it is likely that another participant used different tags to label similar contents. If participants access these contents, it does not necessarily mean that they are unaware of the underlying concepts.

Hypothesis H3 was not supported by the experiment. Our data showed that the average frequency of tag usage and its deviation were lower for non-contributing than they were for contributing participants. However, the differences between the groups were too small for confirming our initial expectations. These results imply that non-contributing participants would not need different support for exploring resources of a community than other participants. For getting more detailed insights on this hypothesis additional data is necessary.

With respect to hypothesis H4, we expected that more actively contributing participants are more focused in their reading habits with respect to the tags they use themselves. The experimental results did not confirm this expectation. Instead, we found the opposite: less active contributors appear to focus more on the tags they use, while more active participants were exploring the content to a larger extent. This finding suggests that more active participants of a community may reflect more on the tags that are used within the community. Thus, more active participants seem to focus on a greater variety of contributions and related their choices of tags to their insights. As our observations were only focused on the implicit and explicit usage of tags, more research is needed to confirm this interpretation of the data.

The initial assumption made in [9] was to hide information about the implicit interests of the non-contributing participants helps them to explore the contributions of a community. Our findings rejected this assumption. Nevertheless, we identified that thresholds for distinguishing incidental tag usage and actual interests are needed. According to our data, these thresholds seem to be independent from the contributions of a participant.

## Implications for reflection support

In this paper we analysed the explicit and implicit usage of tags in an open community portal. Our initial idea was to visualise a participant's interests on the different topics of the community in the tag cloud of the portal.

The goal of this study was to identify if a participant's implicit expressions of interest provide different information than explicit interest expressions. Our findings support

this hypothesis. The implicit interest expressions can therefore be used to stimulate reflection on tags or concepts of which otherwise the participants would not be aware of. However, we identified three important restrictions to this primary finding.

First, for determining interest through the explicit or implicit use of tags, depends on thresholds below which "interest" is not assured. An implication of this is that not all contributions or information requests represent a participant's interest in the same way. In this respect, our data showed no differences for contributing and non-contributing participants. Defining appropriate boundaries for using tags to identify interest, remains an open question for future research.

Second, a large number of tags appear to be used for personal structuring, but seem not to be relevant to the community. This finding confirmed that it was appropriate to exclude tags from the tag cloud if they were not shared.

Third, the "unknown" tags that have been identified as interesting to a participant could be only semantic variations of the concepts that a participant is already aware of. This is not so much a restriction for reflection support, but outlines the possible demand of participants to express relations between the tags they are interested in.

The current study has only focused on the usage of tags by users in teams and small groups. Future work will analyse if integrating visualisations of explicit and implicit interest expressions actually stimulate the reflection on tags and concepts. Future research will address the effect of active and passive reflection on tag and concept visualisation, and develop a better understanding if semantic similarities make a difference for the reflection process.

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