Adaptive Recommendations to foster Social Media Skills in Teaching and Learning Scenarios

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ABSTRACT

The use of social media in the private context is increasing. However, when it comes to integrate social media into everyday vocational life many persons still lack the necessary skills. One reason is that the training of social media skills is not yet sufficiently integrated into the processes of vocational education. Both, students and teachers would therefore benefit from tailored access to online educational resources (e.g. concepts, training materials, lesson plans, tools etc.) which support their professional use of social media. This paper presents a web-based recommender system, called Social Navigator, providing access to respective educational resources for teachers, trainers and students of vocational education. The system adapts to the social media skills of all stakeholders and recommends appropriate online resources. In doing so, the system helps to individually foster the social media skills of all stakeholders which are classified into the ability to search, select, manage, create, communicate and comment information in the social web. First, the concept of the Social Navigator is explained followed by the filters and rankers that are needed to adjust search and recommendations results according to each individual's social media skill level.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous

General Terms

Design, Human Factors

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Keywords

Recommender systems, context sensitive learning, social media, personalized learning

1. INTRODUCTION

Social media have become an integral part of young adults' personal life and become increasingly important also in their working life. A competent and reflective use of social media in the enterprise context requires not only technical skills but more importantly a set of cognitive and social skills related to knowledge exchange such as targeted search, selection, evaluation, comparison, administration, creation or communication of information [8]. To convey the skills that are needed to facilitate a professional use of available channels we argue that social media skill training should become an integral part of curricula in vocational education. We are developing a social media recommender system, named Social Navigator, which is an end-user oriented platform to support the education of social media skills. The Social Navigator offers students, trainers and teachers of ICT vocational education tailored access to online educational resources which support the professional use of social media. The system adapts to the social media skills and contextual factors of the stakeholders and recommends appropriate educational resources that match to the current step in the teaching or learning process. To be able to recommend search and recommendation results depending on each individual's social media skills we developed several filter and ranking functions that are capable of adjusting preferential weights on certain influencing factors in order to learn from the user's behavior by using ontology evolution. The research follows a design science-oriented approach. According to this methodology an artifact is being created in a prototypical approach in order to meet collected requirements fitting to a specific problem description [6]. This paper presents a novel concept that supports context-sensitive and personalized learning in vocational education and training with the goal to foster each individual's social media skills. The newly derived concepts are going to be evaluated in future research using rigorous IS research methods.

2. RELATED WORK

2.1 Social Media Skills

Social media skills describe the capability of adequately applying several types of social media technologies which comes along with the ability of their constructive and receptive use (social media production and consumption) [1]. Thus, a person having social media skills uses social media with the goal to reach specific objectives. Social media skills can be described according to four facets, which form a basis for the Social Navigator [8]: the ability to *select and manage information*, the ability to *understand and rate information*, the ability to *communicate and comment on information* and the ability to *create and edit information*. To each of these facets, several media types are classified.

2.2 Existing Tools

He and Chu [5] present an algorithm framework which makes recommendations based on user's own preferences, the general acceptance and opinions from social friends by carrying out a semantic filtering of social networks. However, the recommendations do not take into consideration each individuals' social media skills or the current step in the teaching or learning process. Fazeli et al. [3] present a trust-based recommender system for teachers. It describes how teachers can take advantage of learning networks as an infrastructure to support lifelong learning. Although the tool monitors and analyzes the teacher's interactions, recommendations are not derived with the aim to foster the users' social media skills. Manousleis et al. [7] present generic architecture layers of adaptive educational hypermedia systems which include the representation and organisation of knowledge about educational content as well as adaptation mechanisms for the user [7]. The analysis of the related work has shown that so far, most tools focus on the recommendation of contents rather than the fostering of social media skills. Although some of the analyzed tools take into consideration usage behaviour, so far no tool focuses on fostering social media skills based on each individual's skill level. Furthermore, none of the analyzed tools has a focus on context-awareness and aspects about personalized learning and teaching.

3. REQUIREMENTS DERIVATION

Based on the shortcomings of the state of the art analysis and the developed social media skills model we derived the following requirements for the Social Navigator:

Requirement 1: The Social Navigator should incorporate several media types. Recommendations about appropriate media types should be derived on the basis of the social media skills model.

Requirement 2: The Social Navigator's frontend has to support functions relevant for teaching and learning scenarios but in a light-weight fashion focusing on relevant functions.

Requirement 3: The Social Navigator should take into consideration the social media skills of each involved stakeholder in teaching and learning scenarios.

Requirement 4: The Social Navigator should be able to be easily adapted in terms of pluggable and easy extension of rankers.

Requirement 5: The Social Navigator should derive recommendations based on the content of vocational education and training.

Requirement 6: The Social Navigator should be able to evaluate complex, semantic interdependencies.

4. CONCEPT OVERVIEW

The Social Navigator represents a novel concept for teaching social media skills according to the four facets described in Section 2.1. As skills are complex to measure, we leverage the analysis of social interactions in vocational education to identify knowledge and skill gaps for students, teachers and trainers. We use this to narrow down to a support that is focused on dealing with identified social media skills issues. The Social Navigator both provides methodological guidance as well as specific contents and resources to help people improve their social media skills. In [9] we describe the overall architecture of the Social Navigator. The search and recommendation engine builds upon the data corpus stored in the data layer. To this end, it uses dedicated APIs for ontology and data access to retrieve content metadata as well as static user profile information and dynamic user behavior data like user-system interaction logs. Data may be stored internally in databases or retrieved from external resources via crawlers, making it possible to connect and index external web pages. The search and recommendation engine contains the filters and rankers to individually adapt search and recommendation results. From the frontend layer, it receives permanent input through the visualization and interaction API, which forwards user events through an event API to an internal event processor. Events include basic user-system interactions like registration, login, and logout, but also may indicate that users consumed certain pieces of content, rated learning objects, or participated in discussions within a certain context. In this line, the events are a central source for personalization and enable proactive recommendations. A gap analyzer component evaluates usage data in real time and leverages information from the domain ontology to identify knowledge gaps related to social media skills or weaknesses within the process of searching for the right media. Based on the usage behavior the Social Navigator identifies knowledge gaps. The statistics in the knowledge base for the respective push recommendations are adapted accordingly, causing the recommender engine to be aware of these changes and to trigger a push recommendation towards the client. Whenever the gap analyzer discovers knowledge gaps for a user, push recommendations are sent to the user via the frontend.

4.1 Domain Ontology of the Social Navigator

Figure 1 shows the domain ontology of the Social Navigator which is modeled using the W3C standard OWL. It depicts the most important concepts as well as the semantic relationships of the involved concepts and stakeholders.

We identified the ontologies FOAF (Friend-of-a-Friend) [4] and ALOCoM (Abstract Learning Object Content Model) [10] as highly relevant to integrate in our ontology. Domain specific concepts about the social media skills in vocational education of the German IT sector, learning fields and target audience have been derived in workshops with representatives from the vocational education sector. In parts, we built an upper-level ontology to integrate the description of

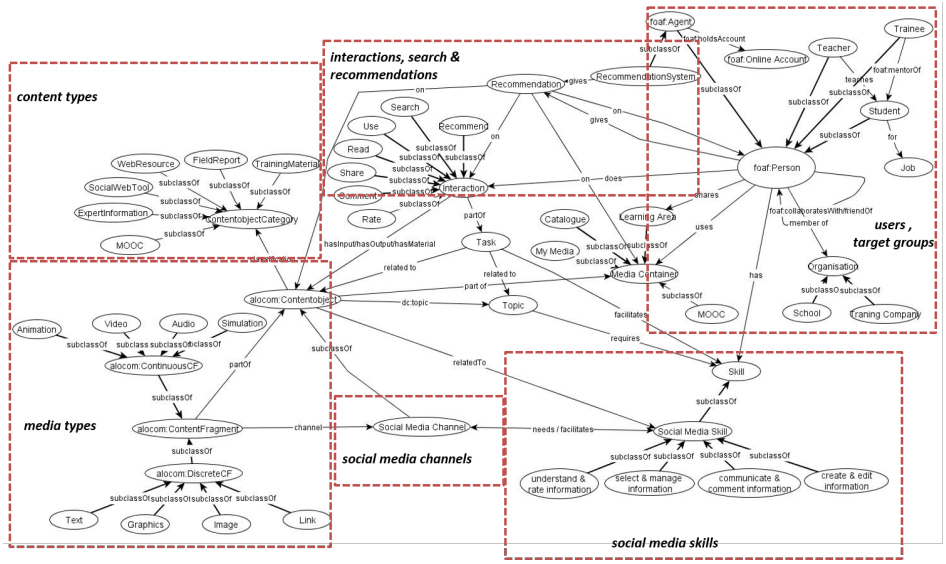

Figure 1: Domain Ontology of the Social Navigator

learning objects and their contents as specified in ALOCoM to associate them with the person-specific information from FOAF. The novel concepts for tasks, skills, interactions and media containers support the specification of new custom concepts. Based on the ontology, users can actively search for *content objects*, and content that match to their current situation in the working process and their personal profile. In addition to searches, the Social Navigator also supports the generation of proactive recommendations which are embedded into the Social Navigator in form of a recommendation stream. The *content objects* are organized in *media containers*. A *task* is related to a specific *topic* in the curriculum and requires specific skills. The chosen approach enables the seamless integration of content from repositories supporting ALOCoM or FOAF. The ontology evolves over time and reflects the dynamics in the user's individual learning process as well as the continuously changing amount of relevant information. A dedicated knowledge adaptation component uses techniques of ontology learning and ontology evolution to adapt the ontology over time.

4.2 Filtering

The search and recommendation component serves as a central entry point for all information needs and requests users have in their teaching or learning processes. Users are either enabled to actively carry out searches or to receive context-aware recommendations through the visualization and interaction API. The received query from the client is enriched with contextual data that can be derived from the user's context. These relationships are extracted from the domain ontology. Within the information retrieval process, the choice of possible return entities has to be narrowed down (e.g. "only show material for specific skills", etc.). The Social Navigator consists of several filters that carry out a first selection of retrieval candidates: The **Competence Model Filter** refers to the selected facet of the social media skill model. It rejects media types that do not match to the selected facet. Matching media types for the skill facet *create information* are e.g. forums, social networks, IM or media sharing sites. Items of another category are not recommended when users carry out interactions within this facet. It is particularly relevant when the skill model is used as entry point to receive recommendations. Here users have an overview about the four facets of to select a facet regarding the skill they are interested in. The **Document Filter** filters contents according to the different media types within the Social Navigator. In the ontology, the required content classification for this filter is depicted within the concept *ContentobjectCategory*. The **Trainer Filter** carries out a first pre-selection of contents that match either to teachers or to students. It separates e.g. items of the category *expert information* for students. Instead of recommending expert information to students, the Social Navigator recommends appropriate *training material* such as learning documents, exercises, courses or learning games, whereas teachers rather receive recommendations about appropriate educational concepts, curricula guidelines or teaching scenarios.

4.3 Ranking

After a first selection of search and recommendation results by the presented filters, the ranking component evaluates these retrieval candidates to bring the recommendation results in a certain order. The goal is to provide the most relevant content for the current situation in the teaching or learning process. To achieve the best results, the Social Navigator uses a plugin-based ranking system. It follows a multi-criteria approach, i.e., several aspects are taken into account when deciding which object should be recommended. For each data type specific ranking configurations exist. Hence, it can be defined which plugins are used together with a certain data type and how the plugin should be weighted. This allows us to easily extend and adapt our system. The different partial ranking of certain ranking plugins are combined in a global ranking function of a ranker (cf. formula 1). $R_u(c_i)$ denotes the overall ranking value for a specific content item i of a certain user (u). The overall ranking function itself consists of various ranking plugins

$p_n(c_i, u)$ that are weighted by a personalized ranking weight $\alpha_{n,u}$. Depending on the specific characteristics of the search scenario, ranking plugins can be added in a multiplication or addition mode. The multiplication mode can serve as a specific filtering within the overall ranking function. The basic mechanisms of this ranking filtering and the usage-based adaptation of the ranking weights are being described in another paper [2].

$$R(c_i, u) = \prod_{m=1}^{k} \alpha_{m,u} \cdot p_m(c_i, u) \cdot \sum_{n=k+1}^{l} \alpha_{n,u} \cdot p_n(c_i, u) \quad (1)$$

The **Competence Ranker** describes which social media skills should be individually fostered according to the four facets of the social media skill model. The information is gained via gap analysis to gain information, which media types have not been used or fostered by a certain user so far. If e.g. a user often comments on information or uploads information within the Social Navigator, it recognizes that this user is able to competently deal within the facet *communicate and comment* on information. If however the same user has not gained any information about *selecting and managing information*, the Social Navigator recognizes this knowledge gap and derives recommendation results that are classified to this facet of the social media skill model.

$$co(c_i, u) = \sum_{x=1}^{r} co(comp_x, u) \quad (2)$$

The **Lucene Ranker** performs a simple full text search over the objects description containing all available profile information and search query terms using term frequencies and categorizations. Apart from the ranking, Lucene is also used for stemming and normalization throughout query evaluation of natural language search queries. The **Usage Ranker** refers to the amount of times an object was used by the users of the Social Navigator.

$$u(c_i, u) = \frac{use(c_i)}{max(use(c_j))} \quad \forall j = 1, \ldots, n, j \in \mathbb{N} \quad (3)$$

The usage of a content item is represented by a numerical value that is adapted over time. The usage count for the given object c_i is divided by the maximum usage counts of all objects. However, as the usage count might be distributed quite asymmetrically, we use quantiles as a compromise between accuracy and computational complexity. The **Rating Ranker** considers the average user rating. In doing so, likes that have been carried out by teachers and trainers are weighted stronger than likes carried out by students.

$$r(c_i, u) = \frac{\overline{r(c_i)}}{\lambda} \quad (4)$$

The rating function puts the average rating of a given content object ($\overline{r(c_i)}$) in relation to the maximum rating of the rating scale (λ). The baseline assumption for this is, that the higher the rating the better the ranking.

5. CONCLUSIONS AND OUTLOOK

Following design-oriented methodology, the created artifact will be evaluated at vocational education schools. In a first step, lab tests are carried out to evaluate the usability of the GUI and the functionality of the search and recommendation results. The feedback from the first evaluation will be integrated in the prototype. The second evaluation will be a large field test in a real life environment to have a sufficient sample size to ensure a qualitative evaluation. Hence, aspects about usability like effectiveness and efficiency as well as a functional and a performance evaluation are going to be carried out. The functional evaluation of the search results will be carried out according to the information retrieval metrics precision, recall, fallout and discounted cumulative gain (DCG).

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