Abstract

Social media nowadays influences almost every part of life. Particularly the educational context is characterized by an increased use of social and digital media in teaching and learning scenarios. Although most students are familiar with the use of social media, many students have problems when it comes to integrate social media in the learning processes of educational and professional context (e.g. in terms of critically evaluating information in the web or professionally responding to comments in the web). Motivated by the lack of social media training in vocational education this paper presents the architecture design of an assistance system which individually fosters the social media skills of all stakeholders in vocational education. The system provides users recommendations about media contents that are adapted to each individual’s social media skills. Teachers, trainers and students have the possibility to apply social media in the professional context and benefit from the right usage.

Keywords

Personalized learning, social media skills, recommender systems, context-sensitive learning.

Introduction

Education of social media skills and technology management in the educational sector has become a topic of high relevance (Larosiliere, McHaney, & Kobelsky, 2013). The last decade has been characterized by an increase of key technologies which have established in many settings. This trend is fostered by an increased use of social media technologies such as weblogs, social tagging or social networks. One of the largest rising groups of users in the web are so called “mobile surfers”. Users are increasingly enabled to communicate, collaborate and network anytime and anywhere. This potential can be efficiently used in the learning context, particularly in vocational education and training. In recent years, the educational sector has become aware of the potential of collaborative creation and sharing of innovative teaching practices which are enabled by an efficient use of social media. These developments have been identified as key challenges for innovations in the educational sector these days (Agostinho, 2008; Carroll, Rosson, Dunlap, & Isenhour, 2002; Koper & Tattersall, 2005). Student’s use of social media has been continuously...
increasing in the last years (McHaney, 2011) even though in the learning context teachers remain the main adopters in the classrooms (Kebritchi, 2010; Pelgrum, 2001). The main issue – particularly for students – is not the lack of technical skills that are required to use social media as most students know how to use most social media technologies. But when it comes to efficiently integrate social media in educational and professional context (e.g. in terms of critically evaluating information in the web or responding to comments in the web) many students have a lack of skills.

Latest results have shown that particularly in the educational sector, research is focusing on more effective and systematic ways to represent teaching guidance and practices about how to develop social media skills in the teaching and learning context (Agostinho, 2008; Marjanovic, 2013). Learning scenarios are characterized by a process which extends into the realm of social interaction (Bandura, 1977; Laufgraben & Shapiro, 2004).

This paper presents the functional design of an assistance system that supports all stakeholders of vocational education like trainees, teachers and trainers to link and integrate social media education with vocational education and training on the job. The assistance system provides users recommendations about appropriate media contents and measures of social media skills in specific learning contexts of vocational (re)training. The main goal is to improve the skills of trainees in dealing with social and digital media. The tool makes an important contribution to strengthening the social media skills of each individual users and training companies in vocational education through context-sensitive and individually tailored recommendations of media contents that take into consideration each individual's social media skills. The research question is: How can the social media skills of all stakeholders in vocational education and training be continuously fostered and individually adapted to the users’ personal profile?

The research method in this paper follows a design science oriented approach (Arnott & Pervan, 2008; Hevner, March, Park, & Ram, 2004). In information systems (IS) research, design science aims at the construction and evaluation of technology artifacts which contribute to the productive and effective application for humans and organizations (Hevner et al., 2004). The construct developed in this paper is the architecture design of an assistance system for vocational education which fosters the social media skills of all stakeholders in vocational education and training by taking into consideration each individual’s social media skills.

In a first step, the foundations are analyzed and synthesized into requirements. Then an overview of the concept and the domain ontology is presented, followed by a discussion of the core components of the assistance system. These components are integrated in the architecture of the assistance system which is presented in the chapter “Architecture of the Vocational Education Assistance System”. The paper closes with a summary of the main results and an outlook on future research.

**Foundations and Related Work**

**Social Media Skills**

Social media skills describe the capability of producing and consuming media contents in a constructive and receptive way (Baacke, 1996; Parola & Ranieri, 2010). A person having social media skills uses social media technologies with the goal to reach specific objectives. A person having social media skills has the ability of Social media skills and knowledge about social media can be described according to four facets (Oloff, Kammerer, & Gerjets, 2013):

1. the ability to understand and evaluate information,
2. the ability to select and manage information,
3. the ability to communicate and comment on information
4. the ability to create and edit information.

The ability to understand and evaluate information describes the ability to critically evaluate the credibility of information in the web. The ability to select and manage information describes the ability of being able to select from a large amount of information the right information. The ability to communicate and comment on information describes the ability of commenting on information in the web and
communicate relevant information to relevant target groups. The ability to create and edit information describes the ability to create and consolidate information in the web.

These four facets are part of the domain ontology which forms the basis for the derivation of search and recommendation results regarding the user’s social media skills. It has been derived in cooperation with psychologists in the field of social media education in schools and vocational education.

**Recommender Systems in the Educational Context**

Several approaches were identified for tools which promote e-learning scenarios in terms of collaboration by the use of social and digital media. Martin, Boticki and Jacobs (2010) present a framework for a mobile application enabling collaborative learning. One of the features of the framework is the integration of external communication platforms like blogs or wikis. The purpose of this platform is to foster the communication of users in learning scenarios. Lee, Kim and Lee (2010) propose an architecture for a social learning platform which is based on collective intelligence models. It consists of four modules, gathering metadata for contents and users, structuring metadata and relationships between contents and users, visualizing the results and mining knowledge from the users’ learning activities. The platform tries to promote the collaborative process by summarizing the knowledge of the different users in a map and visualizing it. Wang and Ng (2012) propose a mobile cloud learning system which promotes collaborative learning and communication of learners in different ways. It provides a question and answer system, which enables users to ask or answer questions of other users. It also provides recommendations about learning groups. Similar users are grouped based on their learning behaviors and have the possibility to collaborate. Users can also upload content to the system and share it with other users. The system automatically builds learning plans for a user based on his/her learning history. Du, Fu, Zhao, Liu and Liu (2013) propose an interactive and collaborative learning platform which integrates social software. Users interact and collaborate in course groups and also have a personal network of friends. When a user collaborates with other users in a course s/he can connect with those. User can receive various kinds of information about members of his/her groups and friends. Users can upload, comment, tag or share content. The system also recommends users and contents to users that might be interesting to them. The project MIRROR focuses on motivating employees to reflect their activities to foster learning from experiences. The goal is to develop creative solutions for current problems that occur in day-to-day work. Employees do not only benefit from their own experiences but also from those of their colleagues who e.g. already successfully coped with specific problems and questions (Balzert, Fettke, & Loos, 2011). MIRROR develops a holistic model for continuous learning by reflection as well as on the development of an “AppSphere” which allows employees to continuously access real-time learning applications (Balzert et al., 2011). Within the project GRAPPLE a learning environment has been developed which supports “lifelong learning” by a technology-based environment which is capable of adapting to the user’s personal preferences (Loos, Leyking, Chikova, & Martin, 2010). The platform APOSDLE supports learning in the context of the current work environment by providing users learning contents, guidance and expert advice (Lindstaedt, Ley, & Mayer, 2005).

**Requirements Derivation**

The literature analysis reveals a lack in recommending contents to users considering their current context and their personal profile, particularly in the context of vocational education. Furthermore, none of the analyzed approaches takes into consideration the development of social media skills and the possibility to create learning spaces that can be private as well as shared with other users.

Based on the analysis results we derived the following requirements for the vocational education assistance system:

- **R1:** Users should receive recommendations that foster their skills in integrating efficiently social media in teaching and learning processes. The recommendations could either point at media (Balzert et al., 2011; Karahocaa et al., 2010; Lindstaedt et al., 2005; Loos et al., 2010), social media skill information (Lee et al., 2010; Loos et al., 2010) or at users with experience in handling certain media or media types (Balzert et al., 2011; Lindstaedt et al., 2005; Loos et al., 2010).
- **R2:** The users' social media skills should be considered in an appropriate manner within every decision support action (Balzert et al., 2011; Lindstaedt et al., 2005; Loos et al., 2010). The teaching and learning
process as well as the carried out task should be considered under consideration of required inputs, outputs and resources (Balzert et al., 2011; Lindstaedt et al., 2005; Loos et al., 2010).

- R3: Users should be able to use, reuse and share media content and media-related knowledge in a simple manner (Du et al., 2013; Lee et al., 2010; Lindstaedt et al., 2005; Loos et al., 2010; Martin et al., 2010). In doing so, users should be able to define common spaces to share with fellow students (Balzert et al., 2011; Lindstaedt et al., 2005; Loos et al., 2010) or topic-related with people of similar interests. Furthermore, users should be able to define personal spaces (Lindstaedt et al., 2005) to have a private learning pool for media contents and related learning material.

**Functional Design of the Assistance System for Vocational Education**

**Concept Overview**

The assistance system is a tool which provides educational methods and links to further information and tools for the design of modern teaching and learning processes in vocational education. Stakeholders of the vocational education process are offered references to new teaching concepts, links or explanations of interesting and relevant educational projects which focus on the development of the social media skills according to the four facets. Furthermore, the tool refers users to teaching scenarios, curricula, didactical methodology concepts and exemplarily teaching scenarios for the intermediation of specific aspects about social media skills. The platform also contains integrated tools for the training of social media skills by integrating task pools, training sessions or electronic textbooks. Additionally, users are enabled to request educational methods (e.g. which teachers can apply in courses) and teaching concepts. These concepts can be either developed within the platform, or users are linked to corresponding concepts in the web that match to their current context and request. The platform is not only a pool for documents, tools and contents. It also focuses on a networking of all stakeholders in vocational education. Hence, the assistance system creates a competence network of teachers, students, trainers and executives which are involved in questions about social media skills. Stakeholders have the possibility to connect their own teaching and learning scenarios with other projects in the assistance system. The following figure depicts the concept of the assistance system for vocational education with its inputs and outputs.

**Figure 1: Concept of the Assistance System for Vocational Education and Training**

Based on the logged usage behavior, the assistance system derives recommendations about teaching scenarios, curricula guidelines, educational methods, tools, content artifacts such as documents or videos, experience knowledge (e.g. in form of field reports), related topics and links as well as further stakeholders in the teaching and learning process of vocational education and training. In doing so, the provided recommendations are distinct from each other and under consideration of each individual's current situation in the learning or teaching process. Furthermore, the assistance system advises how media can be efficiently applied to reach a specific objective in vocational education and training. In doing so, users are recommended suitable media to current questions or problems in the teaching and learning
processes under consideration of their social media skills. In addition to proactive recommendations, users are also able to actively search for media that is suitable in the current step of the teaching or learning process. The individuals’ social media skills are controlled and logged in order to derive support frameworks.

**Components of the Assistance System for Vocational Education**

The derived requirements are reflected in the definition of the core building blocks of the concept which are going to be described in the following sub-sections.

**Knowledge Engineer**

The system needs administration and management activities in order to monitor, analyze and adapt the knowledge processes defined in the system. Although the envisioned system covers many automatic adaptations, semantic disambiguities such as synonyms, homonyms, etc. force human intervention to detangle such problems manually. Optimally, the knowledge engineer is a domain expert who is experienced in the contents that are modeled. In terms of education, a knowledge engineer could be a teacher, professor or tutor.

**Task**

A task describes the current action the user is performing. It has a defined input and a defined output. Task execution is a transformation process that produces output using the given inputs. Hence, recommendations can either refer to inputs or supplementary material that helps the user during task execution. Supplementary material contains either domain knowledge or methodological knowledge. Domain knowledge describes process-specific knowledge, whereas methodological knowledge describes aspects related to social media skills in carrying out certain tasks. Eventually, a task has more than one involved stakeholder, e.g. the person carrying out that task and a supervisor.

**Media**

Media describes all content that can be consumed or produced by the user during his / her work. Hence, it can be used to either describe inputs, outputs or supplementary material in a work process. Media can be distinguished by structural characteristics, e.g. if they are discrete or composite (see Figure 2). Each media type can also be represented by various media formats (e.g. images as jpeg, gif, png, etc.). MIME types or standards such as Dublin Core allow for the definition of a standardized set of metadata. In this context, metadata allow for a standardized and low-effort way of categorizing media information. For more advanced processing capabilities, text mining, video mining, etc. have to be applied. Usually, such methods require high effort in terms of computation time.

![Figure 2 MIME type hierarchy](image)

In our scenario, the media content is a crucial element in the learning process. Hence, we define additional metadata that allow for a fast categorization of the media content, e.g. via topic, social media skill, etc. It is important for the assistance system to dispose as many media material as possible. For this reason, we enable a manual upload of data. Users can upload material according to the MIME type hierarchy. If e.g. a user wants to submit a specific article about using twitter in teaching classes to the assistance system, s/he can upload the article and state meta data about the submitted article, e.g. to which social media skill does the article match, which data type is the article (in this case “text”),
bibliographical information, etc. This information helps to derive recommendations and search results according to specific criteria.

**Context Ontology**

Context describes all related artifacts that either are intrinsic stakeholders or resources in a given task, supplementary material that helps throughout task execution, or external artifacts, phenomena, etc., that directly or implicitly influence the transformation process within a task. From a modeling perspective, a graph-based knowledge model is being created that allows for an association of the aforementioned concepts. The following figure depicts the interdependencies among these concepts:

![Context Ontology Diagram](image)

**Figure 3 Context Ontology**

The figure shows that the context is characterized by arbitrary dependencies among the aforementioned concepts. For the sake of simplicity, the concepts “Topic” and “Media Container” have not been displayed very fine-grained. The ontology clearly shows, that during the execution of a task, the context has to be (re-) evaluated from multiple perspectives. The main entry points hereby are the task itself and the given user. Every of these items have their own specific skill set and competencies. Moreover, the choice of media is narrowed down by the availability for the given user, i.e., whether this contents is contained in the user’s media containers (e.g., library, learning areas, personal space), and the input and output requirements of that specific task. Besides these specific characteristics, also temporal and spatial information can be used to link to certain topics and skills. The central part of the domain ontology represents the concept of *social media skills* with its four facets that have already been introduced in the related work section.

A user is classified into teachers, trainers and students and represents the core addressee of any decision support that is given by the assistance system. To our understanding, this implies that all users need collaborative recommendations to assist them in their work. Thus, sticking to conventional learning scenarios, the user needs assistance in certain knowledge-related tasks. Users have specific skills competencies and knowledge that can be helpful in their work. Within their work they can perform several roles. Each of these roles is associated with a given skill set that must be fulfilled by the user.
The *Library* contains all media that are freely available in the assistance system. All content that is stored here, is already being processed and indexed, i.e. all search and recommendation activities fully work and enable a deep search on this content. The *Web Catalogue* contains external content that cannot be fully indexed by the system for technical, performance or legal reasons. Although the media content itself is not being analyzed, provided metadata, social tags, etc. are used for categorization. Especially with formats such as RSS feeds or news teasers, short information can be categorized in a quick manner. The *Learning Area* represents a user-defined collaboration environment that can be shared with other users. Thus, topic- or skill-specific areas can be created that enable fast information exchange and sharing among users. *My Media* is the personal space for the user to store all his/her private media and learning materials related to his/her social media skills.

Incorporated in the assistance system, the knowledge base evolves over time and reflects the dynamics in the user’s individual learning process as well as the continuously changing amount of relevant information.

**Architecture of the Assistance System for Vocational Education**

Figure 4 depicts the architecture of the assistance system for vocational education and training. The architecture is based on the domain ontology (see previous section) which is modeled using the W3C standard OWL.¹ The data layer is accessible via APIs for data and ontology access. The application layer includes the main components that are required to derive search and recommendation results.

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¹ See http://www.w3.org/2004/OWL/
The VET (Vocational Education and Training) Client is a central app that allows users to manage media and use the knowledge base of the vocational education and training environment for either focused searches or context aware recommendations. The client also holds the “My Media” section for the given user and his learning areas. The VET Plugin plugs into the user’s software. It analyzes the usage behavior of the user, forwards important information about the work context (e.g. topics of the transactions in the system). If possible, also UI extensions will be offered, that display search and recommendation results in the usual work context of the user, i.e. the software he/she is used to.

The Search and Recommendation Interface serves as the central entry point for all information needs and requests, a user might have. In our case, searches and recommendation requests can be triggered through the VET Client. However, whenever the Gap Analyzer discovers knowledge gaps, which the user might not be aware of, push recommendations are given. Furthermore, these knowledge gaps are considered in future search requests. The following figure shows an exemplarily result list of a search query. It depicts two different ways how search and recommendation results can be displayed. The assistance system contains two different views to display search and recommendation results. Figure 5 shows the “tweak-results” view:

![Figure 5. Tweak Results View](image)

In this view users are able to optimize the recommended search results by scroll bars. The weighting is determined by pre-defined rankers, which bring search results in a specific order. Rankers in this example are the Learning Field Ranker and the Competence Model Filter, which refers to the four social media skills that have been introduced in the foundations and related work section. The Learning Field Ranker refers to the specific educational learning fields of a specific vocational job which are not to going to be further specified in this paper. The following figure shows the “browse-view” of search results which is displayed in form of bubbles.

![Figure 6. Browse Results View](image)
This view refers to the same content as the tweak result view. But here, users is shown on the first sight the relevance of the depicted search results symbolized by the size of the bubble.

The Media Event Interface covers all major events in the lifecycle of media. Whenever media content is rated, updated, shared or commented such actions are being notified via this interface. These aspects are covered in the domain ontology as “Interaction”. This notification can either be done via the VET Client or the VET Plugins in the software. Furthermore, it collects all media-related usage data from the aforementioned sources.

The Context Evaluation Component, the received query from the client is enriched with contextual data, that can be derived from the user's individual context or his work context, e.g. the topics associated with the given task. These relationships are extracted from the knowledge base.

The Filtering Component carries out a first selection of retrieval candidates. Within the information retrieval process, the choice of possible return entities has to be narrowed down. This is being done by hard filter criteria (e.g. “Only show videos”, “Only show material related to specific social media skills”). After a first pre-selection of search and recommendation results, the ranking component evaluates the retrieval candidates according to several criteria: The appropriateness for the given social media skill level (Competence Ranker), the gathered preferences regarding topics, the semantic fit to the work process or learning field etc. The goal is to provide the most relevant content for the given learning situation.

The Catalogue Crawler is a focused web crawler that crawls resources. Beside simple RSS feed extraction, complex navigation structures of websites and extraction patterns for the gathered information objects can be specified. All these aspects can be configured by a knowledge engineer. The Information Indexer gathers all information received from the various internal or external information sources. It brings the metadata gathered from these sources in the internal knowledge representation of the knowledge base. Moreover, using various mining techniques, the raw data of the media contents is analyzed and correlated with top topic maps. Especially the gathered usage data update these correlation matrices over time, resulting in more accurate recommendations.

The Gap Analyzer evaluates usage data in real-time and leverages information from the knowledge base, in order to identify knowledge gaps related to social media skills (e.g. weaknesses in the media search strategy are detected, guidelines for the creation of certain content are neglected, etc.). The statistics in the knowledge base for the respective push recommendations are adapted accordingly, causing the knowledge base to trigger a push recommendation towards the client. If e.g. a user has carried out many interactions that are classified to the facet “communicate and comment” on information, but s/he so far has not carried out interactions classified to the facet “select and manage information”, the user will receive more recommendations that are classified to the skill of selecting and managing information.

The Knowledge Base continuously evolves and reflects the dynamics of the user's individual learning process as well as the ever-changing amount of relevant information available. The Knowledge Adaptation component uses techniques of ontology learning and ontology evolution to adapt the knowledge base over time. This could either be triggered by the indexing of new or updated content or the analysis of usage data. The knowledge adaptation component will also provide a user interface for knowledge engineers to reify gathered statistical relationships into model relationships that can be queried in searches and recommendations. Changes in the user's social media skills can be continuously adapted. Hence, the knowledge base evolves with the user's social media skills. The Knowledge Base holds all relevant information about media, learning processes, tasks and social media skills.

Conclusions and Outlook

This paper presented a novel concept for media usage under consideration of social media skills in vocational education. Based on an analysis of the foundations in research about social media skills and the capabilities of contemporary e-learning solutions which support media recommendations, requirements have been derived for the conceptualization and design of the assistance system. This tool enables the context-aware recommendation of media contents, media competence measures and information, as well as users with similar learning goals or helpful knowledge in a given problem situation. The context ontology presented in this paper has a focus on vocational education. However, the presented concept serves as a blueprint and could be also applied in other domains.
In future work, the assistance system will be implemented within a research project carried out in cooperation with several vocational education schools. In a similar manner, the requirements for filtering and ranking criteria will be further elaborated. Furthermore, relevant information sources to serve as web catalogues will be defined for the use case.

After the core system as described has been implemented, the evaluation will be conducted in the following way:

1. **Analysis of user requirements**: Gather feedback for UI design and configurations for filters, rankers and required information sources and enterprise software.

2. **Configuration of the system / Implementation of plugins**: Configuration of the filters, rankers and crawlers. Implementation of client plugins for the identified enterprise software.

3. **Performance analysis versus a test data set**: The system will be analyzed according to state-of-the-art information retrieval metrics such as precision, recall or fall-out.

4. **Lab tests with test users**: Lab tests will be carried out with test users to gather feedback for UI design, prioritization of features and improvements of the prototype.

5. **Large-scale field test in a real-life vocational education environment**: In a final phase the application will be tested in a real-life environment of vocational education with a sufficient sample size of users to ensure a qualitative evaluation of the research hypotheses.

Following iterative research and development principles, all steps can have back-loops to previous steps, in order to align requirements from users and target groups with results from conceptual work using rigorous research methodology.

**REFERENCES**


