

Conceptual design of a tool for personalized and context-based learning on the job

Christina Di Valentin, Julia Hegmans, Andreas Emrich, Dirk Werth, Peter Loos

Abstract—An appropriate use of media is a key success factor for communicating information efficiently in educational and professional context. The vocational education and training community would benefit from tools that foster media usage both from trainee and teacher / trainer perspective. Aspects like co-creation and information sharing influence collaboration in the web. Hence, competence-related knowledge is crucial to use media in an efficient way. This paper presents a domain ontology and the conceptual design of an assistance system which fosters an efficient use and reuse of media content in professional context by receiving recommendations about appropriate media usage.

Index Terms—Context-based learning, decision support, assistance system, vocational education.

I. INTRODUCTION

THE last decade has been characterized by an arising popularity of key technologies which have established in many settings [1], [2]. The educational sector has become aware of these developments and the potentials that come along with these trends [3], [4]. Most users of social and digital media are familiar with those applications in private context [5]. However, when it comes to efficiently integrate social media in professional or educational context users often show a lack of competences.

The main goal of the presented research is to improve the social media skills of all stakeholders in vocational education and training (VET). Therefore, the conceptual design of an assistance system is presented which supports trainees, trainers, teachers and staff developers in VET to develop and apply social media skills in their teaching and learning processes. In doing so, users are individually recommended appropriate media contents that match to their current context in VET. Thus, trainees learn how to efficiently use social media tools in their apprenticeship whereas teachers and trainers are provided educational concepts for teaching scenarios or training programs. The research method follows a

design science oriented methodology, which aims at the artificial construction and evaluation of innovative artifacts [6], [7].

First, a collection of relevant definitions in the context of decision support in VET is given in Chapter 2. The derived definitions have been classified into models and methods, which will be implemented in a next step. Furthermore, this chapter gives an overview about related work of recommender systems that support learning at the workplace. Based on the state of the art, shortcomings for the concept of the assistance system are collected as requirements. Chapter 3 explains the concept and the domain ontology of the VET assistance system, whereas Chapter 4 presents the developed software design. The paper closes with a summary and gives an outlook on future research.

II. RELATED WORK AND REQUIREMENTS DERIVATION

A. 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) [8]. Thus, a person having social media skills uses social media technologies with the goal to reach specific objectives. Social media skills and knowledge about social media can be described according to four facets, which also form a basis for the assistance system [9]:

- 1) the ability to search and select information,
- 2) the ability to manage information,
- 3) the ability to communicate and comment on information and
- 4) the ability to create information.

B. Recommender and Collaboration Systems for E-Learning Scenarios in Professional Context

Several tools were identified which use social media in the context of VET or promote the use of such. Thereby, collaboration and personalized learning facilities as well as recommender systems were key factors in the selection of these tools. The *TARGET platform* provides multiple ways of interaction amongst learners with the objective of sharing experiences and collaborative reflection such as annotations, blogs, wikis, microblogging, tagging and creation of private

Manuscript received September 25, 2013. This work was supported in part by the European Social Fund and the Federal Ministry of Education and Research under Grant 01PZ12010D. The authors take the responsibility of the contents. C. Di Valentin, A. Emrich, D. Werth and P. Loos are with the Institute for Information Systems (IW_i), German Research Center for Artificial Intelligence (DFKI), Saarbruecken, Germany (+49) 681 85775 5239; e-mail: {Christina.Di_Valentin | Andreas.Emrich | Dirk.Werth | Peter.Loos}@dfki.de. J. Hegmans is with BITKOM—German Federal Association for Information Technology, Telecommunications and New Media, Berlin, Germany (+49) 3027576-133; e-mail: j.hegmans@bitkom.org.

groups [10]. *APOSDLE* recommends experts and colleagues' best practices based on the knowledge level and task of the learner [11]. Furthermore, the platform facilitates a networking of its users [11]. *Mediencommunity 2.0* is a tool for all stakeholders in VET which consists of the two main areas [12] "information and training" as well as "networking and collaboration". It is mainly used in terms of exam preparation [12]. There also exists a trainer community on how to apply multimedia methods in class. The project *MIRROR* focuses on motivating employees to reflect their operations in order to foster learning experiences. The main goal is to develop creative solutions for current problems that occur in day-to-day work [13]. The *Blok Online Portfolio* has been developed especially for the dual apprenticeship system, motivating

apprentices to write a personalized learning diary on a blog and offering tools to get in contact with teachers and trainers [14]. Collaborative knowledge building and training for teachers in VET and adult education about the use of social media in class is the prime objective of the *SVEA platform* [15]. Individual and group dashboards provide the user news, whereas group work is facilitated by to-do lists, calendar, microblogging, bookmarking and private messaging. The project *India Web 2.0* developed a platform with teaching scenarios for the use of wikis, podcasts and blogs in vocational training for IT application specialists [16]. The following table presents the results of the related work analysis and describes whether an approach or tool has fully met a requirement (+), partially (o) or not at all (-).

TABLE I
RELATED WORK ANALYSIS

		[10]	[11]	[12]	[13]	[14]	[15]	[16]
Content	subject-related	+	+	+	+	-	-	-
	social media literacy-based	-	o	-	-	-	+	+
Provided Content	structured training units	+	-	+	+	-	+	+
	recommendation of content	+	+	-	+	-	-	-
	recommendation of users	-	+	-	+	-	-	-
	integration of external content	-	-	o	-	-	-	-
Collaboration	creation of learning groups	+	o	+	-	-	+	-
	wikis/blogs/forums/chat	+	o	+	o	+	+	-
	add content	+	+	+	+	-	+	-
	share content	-	o	-	+	-	-	-
	rate content	+	o	+	o	-	-	-
Recommendation	content (personalized)	+	+	-	-	-	-	-
	content (context based)	-	+	-	+	-	-	-
	users (personalized)	-	+	-	-	-	-	-
	users (context based)	-	+	-	+	-	-	-
	processes (personalized)	-	o	-	-	-	-	-
	processes (context based)	-	o	-	+	-	-	-

The table shows that so far there is a lack in recommending contents to users with the goal to increase their social media skills. Furthermore, current tools so far do not support the recommendation of users to other users in the learning or teaching process under consideration of increasing media literacy. Three tools provide learning areas where users can group share and recommend others. However, none of the approaches offers storage functionality, to synchronize media contents with a device and the online library of the user to access content offline.

Based on the gap analysis from the related work, we derived the following requirements for decision support in VET: Requirement 1: Stakeholders must be able to use, share and reuse media content as well as media related knowledge in a simple manner. Thereby, users should be able to define common spaces to share with fellow students or topic related with people of similar interests. At the same time users should also be able to define personal spaces to have a private learning pool. Requirement 2: Users should receive recommendations that help them with their media usage and they should be able to explicitly search for media contents. Thereby, every decision support action should consider the specific social media skills of the user as well as the current

step in the work process. Requirement 3: External information should be integrated to keep the system up to date.

III. FUNCTIONAL DESIGN OF THE ASSISTANCE SYSTEM

A. Overview of the Concept

The VET assistance system is a tool which provides all stakeholders of teaching and learning processes information in form of links, documents or tools (tests, e-books, etc.). If a teacher e.g. carries out a project which aims at an integration of iPads in teaching classes, s/he first might want to find out if this project has been carried out at other schools or trainee companies. An interface to the web enables the teacher to receive information about similar projects e.g. in form of teaching scenarios, educational methods, teaching concepts, didactical methodologies, curricula or relevant media. The assistance system is not only a pool for documents, tools and further contents. It also focuses on a networking of its users. In our example the teacher could contact other teachers and trainers via the assistance system who already dealt with this topic. Hence, the experience knowledge of each individual can be efficiently integrated in teaching and learning processes. Thereby, an increase of the user's social media skills is always

in the focus. Hence, several functionalities are provided by the assistance system. Users receive recommendations about an efficient use of media contents under consideration of their current situation in the learning or teaching process. In addition to proactive recommendations users are also able to search for relevant media under consideration of their current working context. The individuals' activities are logged to derive support frameworks and best practices. By this means,

an adjustment of content, pedagogy and technology can be achieved.

B. Domain Ontology

The following figure shows the knowledge model that depicts the associations of all related concepts that are needed to derive the recommendation results.

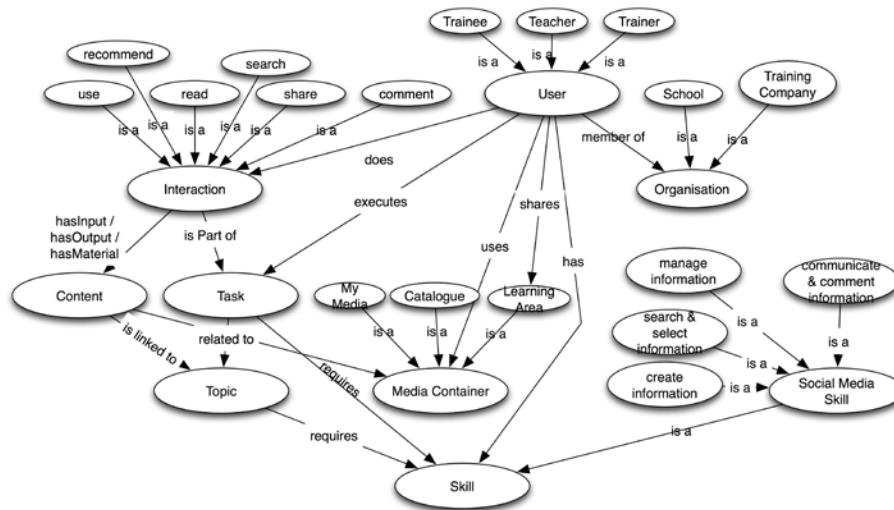


Figure 1 Domain Ontology.

Users interact with specific media contents when they carry out a specific task. Thereby, users can actively search for content and they are recommended content that matches to their current context. The content is organized in form of media containers consisting of the components *My Media*, *Catalogue* and *Learning Area* which structure will be described in the following section. A task is related to a specific topic in the curriculum of vocational education and training (e.g. “requirements analysis” within the apprenticeship of “Qualified IT specialists”), which requires specific social skills that are described according to the four facets (see Chapter 2).

recommended media contents by dragging them into their personal learning area *My Media*.

IV. SOFTWARE DESIGN

When logged in to the system, users get proactive recommendations on the welcome page via the *Activity Stream* about media contents that match to their current context (e.g. videos, news, tweets or announcements from social networks, etc.). At the welcome page, users can select between the functionalities *My Media*, *Learning Area* and *Catalogue*.

The *Catalogue* comprises all media that are freely available within the VET assistance system (see Fig. 2). The stored media is already processed and indexed. Search and recommendation activities enable deep searches on media contents (cf. Req. 2 and 3). Users interested in specific media can request further details about selected items. Search and recommendation results can be rated in form of an “I like Button”. Additionally, users have the possibility to tag and comment on information. Users can manage and classify



Figure 2 Catalogue View of the assistance system.

The component *My Media* describes the users' personal area in which they can import and store media content that has been selected in the Catalogue or in the Activity Stream. In doing so, users can classify media contents according to their preferences (Req. 1). The following figure shows how media contents can be arranged within this component:



Figure 3 My Media View.

The *Learning Area* covers aspects about collaboration within learning and teaching activities. Users can bundle media contents that have been stored in *My Media* regarding specific aspects and share them with other members of the VET system (e.g. videos and documents about creating and moderating a blog). Hence, teachers can prepare lessons and share contents with their classes, whereas trainers invited to specific groups can stay up to date about current teaching and learning content and adapt their trainees' tasks to current teaching activities (Req. 1). Trainees can create learning areas to collaborate with other users (e.g. in terms of group work). Additionally, trainees are recommended users to contact if specific questions within a learning process arise. Learning areas can also be published in the *Catalogue* (after agreement of their creators), where they can be found by other users of the system. Hence, other users can benefit from already published learning areas.

V. CONCLUSIONS AND OUTLOOK

This paper has presented the concept and software design of a tool that supports the development of social media skills in the workplace by recommending its users the right usage of digital and social media tools. A comprehensive analysis of already existing recommender systems for e-learning scenarios has shown that even though a number of tools concerning collaboration and participation in learning scenarios exist, so far there do not exist tools which provide personalized and context aware recommendations of media contents in VET.

In a next step the conceptual design will be implemented and evaluated according to rigorous design science methods within a research project. The domain ontology presented in this paper will be refined by relevant topics and tasks on the basis of expert interviews and focus groups from the field of VET. Furthermore, the ontology will be expanded by already existing ontologies such as FOAF (Friend of a Friend) and ALOCoM [17]. The developed ontology will improve information sharing and communication between training companies and vocational schools as well as the media competence of each individual based on personalized recommendation of teaching and learning material. In addition to the ontology, filtering and ranking criteria for the evaluation of search results and recommendations will be developed. The implementation will follow an iterative approach to be able to continuously integrate feedback loops.

REFERENCES

- [1] K. P. Patten and L. B. Keane, "Enterprise 2.0 Management and Social Issues," in *Americas Conference on Information Systems (AMCIS)*, 2010, pp. 1–8.
- [2] E. Selim, M. Granitzer, S. Happ, S. Jantunen, B. Jennings, P. Johannesson, A. Koschmider, S. Nurcan, D. Rossi, and R. Schmidt, "Combining BPM and social software: contradiction or chance?"
- [3] J. M. Carroll, M. B. Rosson, D. Dunlap, and P. Isenhour, "Frameworks for Sharing Knowledge: Towards a Professional Language," in *Hawaii International Conference on System Sciences (HICSS)*, 2002.
- [4] S. Agostinho, "Handbook of research on learning design and learning objects: issues, applications and technologies," L. Lcky and H. PA, Eds. IGI Global, 2008.
- [5] C. Di Valentin, A. Emrich, D. Werth, and P. Loos, "Developing Media Competence in Vocational Education – Architecture Design for Context-sensitive and Individual Learning," *IEEE Learning Technology (IEEE-TCLT)*, vol. 15, no. 1, pp. 1–5, 2013.
- [6] D. Arnott and G. Pervan, "Design Science in Decision Support Systems Research: An Assessment using the Hevner, March, Park, and Ram Guidelines," *Journal of the Association for Information Systems (JAIS)*, vol. 13, no. 11, pp. 923–949, 2012.
- [7] A. R. Hevner, S. T. March, J. Park, and S. Ram, "Design Science in Information Systems Research," *MIS Quarterly*, vol. 28, no. 1, pp. 75–105, 2004.
- [8] D. Baacke, "Medienkompetenz, Begrifflichkeit und sozialer Wandel," in *Medienkompetenz als Schlüsselbegriff*, A. von Rein, Ed. Bad Heilbrunn, 1996, pp. 112–124.
- [9] C. Oloff, Y. Kammerer, and P. Gerjets, "Knowledge and skills for the use of the social web in vocational IT-education," in *Lernen und Web2.0 – von der Theorie zur Praxis*, 2013.
- [10] L. M. Hokstad, E. Prasolova-Förland, and M. Fominykh, "Collaborative Virtual Environments for Reflective Community Building at Work: The Case of TARGET," *Computer-Supported Collaborative Learning at the Workplace*, vol. 14, pp. 167–183, 2013.
- [11] S. N. Lindstaedt, T. Ley, and H. Mayer, "Integrating Working and Learning with APOSDLE," in *Proceedings of the 11th Business Meeting of Forum New Media*, 2005.
- [12] A. König, I. Buchem, and L. Goertz, "Virtuelle Lerngemeinschaften zur Vorbereitung auf die berufliche Abschlussprüfung. In: Bundesinstitut für Berufsbildung," *Berufsbildung in Wissenschaft und Praxis*, vol. 41, no. 3, pp. 30–33, 2012.
- [13] S. Balzert, P. Fettke, and P. Loos, "Enhancement of Traditional Business Process Management with Reflection - a New Perspective for Organisational Learning?," in *European Conference on Technology Enhanced Learning (EC-TEL)*, 2011.
- [14] S. Schulze-Achatz, C. Albrecht, C. Lehmann, and G. Schubert, "Zusammenfassung des Abschlussberichts zur wissenschaftlichen Begleituntersuchung im Projekt „BLok – Online-Berichtsheft zur Stärkung der Lernortkooperation," Dresden, 2012.
- [15] P. Newrly, I. Op de Beeck, W. Van Petegem, L. Marcellin, and T. Toole, "SVEA - A demonstration on how to promote the web2.0 uptake in VET and adult training in a sustainable way," in *EDEN Conference*, 2011.
- [16] "India Web 2.0." [Online]. Available: <http://india.mixxt.de/networks/content/index>.
- [17] K. Verbert, J. Jovanovic, E. Duval, D. Gasevic, and M. Meire, "Ontology-based learning content Repurposing: the ALOCoM Framework," *International Journal on E-learning*, vol. 5, no. 1, pp. 67–74, 2006.

Christina Di Valentin holds a diploma in Business Administration with a major in Computer Science. She is a researcher at the German Research Center for Artificial Intelligence in Saarbruecken, Germany. Her main research areas include business models, recommender systems, semantic web and business process management.

Julia Hegmans is project manager for media literacy at BITKOM e.V. acting as a liaison between the KOMMIT project and IT companies. She also held positions as learning and development specialist at Coca-Cola Erfrischungsgetränke AG and as a secondary school teacher.

Andreas Emrich received a Master's degree in Business Administration and Computer Sciences. Currently he is a researcher at the German Research Center for Artificial Intelligence. His main research areas include recommendations of processes and services, semantic task environments and proactive information delivery.

Dr. Dirk Werth is head of the project group "Business Integration Technologies" at the German Research Center for Artificial Intelligence. His main research activities comprise collaborative business processes, business integration and advanced business information systems.

Prof. Peter Loos is director of the Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence. His research activities include business process management, information modeling, enterprise systems, software development as well as implementation of information systems.