Investigating the Suitability of Mashups for Informal Learning and Personal Knowledge Management

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Abstract. It has been shown that most of our daily learning takes place outside formal settings (e.g., seminars or trainings) where knowledge is transferred from a teacher to a learner and a certificate is often the result. This so-called informal learning is a life-long process where individuals continuously acquire knowledge. It constitutes an important element of every individual's personal knowledge management (PKM) process. Web 2.0 concepts and techniques facilitate communication with distributed individuals and help knowledge workers to cope with the immense information overload by simplifying the organization, integration, and reuse of information scattered across diverse content sources. In this paper, we investigate mashups in terms of their suitability for supporting and improving the quality of PKM and hence informal learning. This is done by analyzing which mashup features contribute to a set of information skills and learning objectives. Our analysis shows that common mashup features have the potential to broadly support designated information skills of knowledge workers.

Keywords: Mashups, Informal Learning, Personal Knowledge Management, Information Skills, Learning Objectives

1 Introduction

Knowledge workers are employees working in information-intensive organizations where they develop and use knowledge throughout their daily work. They are not supervised but manage themselves and decide on their own what and how they learn [1]. Nowadays, knowledge workers face an immense overload of information that is scattered across diverse content sources within the company (e.g., emails, file system folders, or repositories) and in the cloud (i.e., the public Web). Such information can either be pulled by the knowledge worker himself (e.g., file-system, web) or be pushed to him from an external party (e.g., the email system). Nevertheless, both approaches require effective mechanisms for finding, evaluating, structuring, and storing relevant information even if it is scattered across technical systems and organizational boundaries. This can be called Personal Knowledge Management (PKM). Once the knowledge worker has found and evaluated relevant information, he has to connect this new information to his existing knowledge structures in order to facilitate learning. From the perspective of organizational learning, he also needs to externalize,

store, and distribute his knowledge and experiences within the organization. However, knowledge management is often neglected in an organization, so that knowledge workers often perceive such activities as overhead instead of as making work easier [2].

Mashup applications seem to have the potential to broadly support PKM and to stimulate both the exchange of information and learning within an organization. The term *mashup* refers to an ad-hoc composition of information and services coming from different sources into new services [3]. Used wisely, they can help to create a corporate awareness of how employees can first refine their PKM strategies, and then contribute to the corporate knowledge. Consequently, mashups can help to establish an organizational culture of tool-supported PKM, which also comprises informal learning during daily work. In addition, Web 2.0 concepts in general and mashups in particular provide low-threshold, lightweight mechanisms for supporting the management of information and knowledge at various stages.

This paper investigates which kinds of mashups exist and how they support PKM and individual learning. For this purpose, it addresses the research question of whether specific mashups help the knowledge workers to acquire information skills as defined by Dorsey [1]. Chapter 2 defines our understanding of PKM and informal learning. Then, Chapter 3 describes common features and types of mashup applications. Chapter 4 describes the seven information skills by Dorsey [1] and maps them to the learning objectives taxonomy by Anderson and Krathwohl [12] as well as to the features of mashup applications. Chapter 5 provides a conclusion regarding the potential of PKM and informal learning mashups and suggestions for future research.

2   Informal Learning and Personal Knowledge Management

During most of their working time, knowledge workers are passing through an incremental process of acquiring, evaluating, organizing, analyzing, presenting, and securing information [1]. This is done, for example, when they go through their emails, browse the web, talk to colleagues, or read articles. Individual learning is an integral part of these PKM activities, since knowledge does not only need to be retrieved, evaluated, and managed but must somehow be transformed into some kind of personal knowledge (even if it is only knowledge about where to find the required information). The process of constructing new knowledge from an individual's information and embedding it into existing knowledge structures is called learning.

Learning is *informal* when it takes place outside formal learning settings, such as scholarly or university education where the learner usually intends to receive some kind of certificate. Such learning is an integral part of our lives – even if they were to try, humans could not "not learn", but learning is omnipresent even outside the classroom. The Faure report (1973) [4] states that informal learning comprises about 70 percent of human learning. The notion of informal learning refers to a container term that is not clearly defined [5]. For this reason, there exist many diverse understandings about informal learning. Dohmen sees informal learning as the most fundamental form of human learning [6]. Informal learning cannot be planned or accessed, and can hardly be evaluated by looking at its ROI. This makes it difficult for organizations to

access the value of informal learning. Nevertheless, there have been several publications that show the importance of informal learning for an organization [7]. In the context of this paper, informal learning often takes place in an unconscious and accidental way (e.g., a casually learned aspect in a dialog) but can also be intended (e.g., intended learning of a topic by reading an article). Informal learning takes place outside formal settings and supports life-long learning, where the learning activities are initiated by the learner and the learning process continually adapts to the current context (e.g., the current project). A large part of informal learning happens through direct interactions with people because most knowledge is not externalized and, instead, is located inside people's minds. Mashups have the potential of fostering the willingness for and the quality of informal learning because they can bridge geographic distances, help to identify experts, provide support for interaction, pro-actively recommend context-sensitive information, or automate time-consuming processes.

In order to support informal learning, organizations should provide learning-conducive working tasks, workplaces, and working conditions. In such environments, knowledge workers can decide what they learn, how they learn (e.g., via trial and error, conventional (face-to-face) or technology-enhanced conversations (e.g., via instant messenger), examples, or observations), and from which source they will elicit knowledge. In addition, they have the time to reflect on what they learned, how they did it, and how to connect new information with existing knowledge.

Effective support of an individual's information learning activities can be seen as one contributor to the PKM process. In modern knowledge-based societies and organizations, PKM is one of the major challenges of knowledge management (KM), since it provides ways of supporting the productivity of an individual knowledge worker [2] by addressing the increasingly knowledge-intensive nature of work [8]. In addition, the goal of PKM is that employees thereby contribute to the overall corporate body of knowledge and expertise in the organization. PKM comprises managing and supporting personal knowledge and information so that it is accessible, meaningful, and valuable to the individual [2]. Thus, informal learning is an integral part. PKM also includes the organization of personal information sources in order to reduce information overload and the development of personal networks in order to foster information acquisition and informal learning. Nevertheless, the personal side of KM seems to be underestimated in many organizations [2].

3   Common Features of Mashups

Mashups as a subset of situational applications are Web-based applications that refer to an ad-hoc composition of services (either data or functionality) stemming from different sources to create entirely new services with added value that were not originally provided (and intended) by any integrated source [3, 10]. In doing so, mashup developers can leverage the whole range of Web 2.0 techniques in order to deliver rich user experience. Wong and Hong have surveyed the diverse types of mashups as well as their features [9]. The following list shows some of those types with examples:

- **Syndication**: The mashup summarizes multiple websites/services or data sets (e.g., Vidmeter.com aggregates videos charts from multiple websites, Yahoo Pipes (pipes.yahoo.com) enables users to create combined feeds).
- **Search**: The mashup provides a search over multiple external data sources (e.g., Kayak.com aggregates multiple search results from different engines).
- **Visualization**: The mashup provides the user with some kind of visualization of external data sets (e.g., liveplasma.com visually suggests to users those artists who might be of interest by leveraging the Amazon API).
- **Real-time Monitoring**: The mashup allows the user to monitor or observe one ore more external services as a real-time data set (e.g., www.pimpampum.net/rt visualizes in real time the stream of information into Flickr).
- **Widget**: The mashup is a reusable micro-application that runs within a runtime environment (e.g., display of a world-time clock running on a portal or a blog).
- **Personalization**: The mashup makes use of the user's personal information exposed by other websites/services (e.g., leveraging personalized feeds of Del.icio.us as input source) or enables the construction of a personalized data set from the original service (e.g., the mobile shopping service Wishpot.com).
- **Folksonomy**: The mashup leverages a tagging mechanism for organizing its content. Tag clouds help to navigate through the content (e.g., TagBrowsr.com as an alternative way for browsing Flickr content).
- **Alternate UI & In-situ use**: A mashup provides an alternative UI to external services (e.g., oSkope.com provides a visual interface to Amazon, Ebay, etc.). In-situ use refers to mashups that support specialized usage of a service outside the typical use case (e.g., HeyWhatsThat.com utilizes GoogleMaps to describe mountains and terrain areas to users).
- **Focused View of Data**: The mashup indexes or categorizes a subset of another service's entire content (e.g., Youtorials.com is an assemblage of video tutorials from YouTube).

In addition to this list, the following features seem useful for building mashups that support PKM. They primarily aim at social networking aspects where people are engaged in terms of commenting or rating.

- **Recommendation**: The mashup utilizes recommended content originating from social communities or where users suggest related content with regard to the content of the Web page (e.g., recommended Del.icio.us bookmarks).
- **Rating**: The mashup shows content that was either assessed by users or that has been referred to often (e.g., Amazon's stars, bookmarks in Del.icio.us).
- **Commenting/Annotating**: The mashup integrates all kinds of comments attached to some content (e.g., sticky notes in Diigo.com).
- **Sharing**: The mashup enables users to share contents with others (e.g., users share video clips within Youtube.com). Sharing requires a social networking infrastructure (e.g., Diigo.com provides friends and groups to share content with).
- **Collaboration**: The mashup enables the users to collaborate on creating or annotating content (e.g., users jointly assemble video clips in Kaltura.com).

4 Supporting Knowledge Workers through Mashups

Since Drucker [10] introduced the term knowledge worker, society in many developed countries has turned into a knowledge society (economy). Nowadays, Davenport [11] estimates that 28% of the workforce are knowledge workers who "have high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge."

Dorsey [1] has worked out a list of seven information skills of knowledge workers. He describes "Personal Knowledge Management, and its seven information skills, as a framework for the education of those preparing for knowledge work roles […]." In particular, Dorsey identified:

1. **Retrieving Information** in order to "develop an understanding of the relative usefulness of these different information resources to support both […] actions and […] personal development" of knowledge workers
2. **Evaluating Information** in terms of evaluating and assessing information, its quality, and its relevance
3. **Organizing Information** by developing "strategies consistent with the nature of […] work, with […] learning styles, and […] the nature of collaborative relationships they may have."
4. **Collaborating around Information** means supporting "the process of working smarter, rather than merely harder, and to overcome obstacles in the form of the absence of social cues for appropriate behavior. The time spent in more face-to-face and richer electronic collaborative environments needs to be devoted to higher value activities while the actual sharing of information can be done through mechanisms that involve less collaborative activity."
5. **Analyzing Information** "builds on the organization of information, but goes beyond it in its emphasis on the importance of frameworks, models, and theories […]. Analysis of information addresses […] extracting meaning out of data."
6. **Presenting Information** "using […] new technologies mean that increasingly knowledge workers will need to become familiar with the work of the communications specialist, the graphic designer, and the editor."
7. **Securing Information** means that knowledge workers should frame tradeoffs regarding confidentiality, integrity, and availability.

As depicted in the table, mashups have the potential of supporting knowledge workers in acquiring a broad variety of such information skills. The middle column contains the related cognitive activities needed to achieve these skills. The verbs used in this column were defined according to the learning objective taxonomy of Anderson and Krathwohl [12]. The right column proposes assigning these cognitive abilities to practical activities in terms of mashup features (see Chapter 3). In the taxonomy, feature support from mashups ranges from basic levels such as "remembering" and "understanding" to higher levels, e.g., "analyzing" and "evaluating".

Inform. skill	The knowledge worker does …	Mashup features
Retrieving Information	• **understand** relationships between domain concepts.	• Folksonomy
	• **differentiate** between relevant and non-relevant keywords. ❷	• Folksonomy ❶
	• **use** the search function.	• Search
	• **recognize** already stored and evaluated sources, infor-	• Personalization, Focused

Inform. skill	The knowledge worker does …	Mashup features
	mation, contacts, and knowledge based on search results. •**evaluate** which strategies are appropriate for retrieving relevant information. ❹	View of Data • Rating, Recommendation, Commenting/Annotating ❸
Evaluating Information	• **select** quality criteria and standards for evaluation and **interpret** the provided information. • **judge** the information chunks and sources based on criteria and standards.	• Personalization, Commenting/Annotating • Rating, Recommendation
Organizing Information	• **represent** information. •**classify** information chunks in such a way that they might be of future use for the learner himself or others. • **construct** models in order to explain semantic relationship between domain concepts. • **summarize** several information chunks. ❺	• Widget, Alternate UI • Folksonomy, Syndication • Folksonomy • Syndication, Focused View of Data ❻
Collaborating around Information	• **collaborate** by interacting, explaining, and discussing with others. • **represent** information to others. • **compare** and **interpret** perceptions with those of others. • **share** information with others (learning by teaching, e.g., by creating a tutorial).	• Collaboration • Visualization, Alternate UI, Commenting/Annotating, Widget • Rating, Commenting/ Annotating • Sharing, Recommendation
Analyzing Information	• **distinguish** and **select** relevant and non-relevant information. • **outline** and **structure** chunks of information. • **extract** (deconstruct) common concepts.	• Commenting/Annotating, Rating, Recommendation • Commenting/Annotating • Syndication
Presenting Information	• **paraphrase** and **represent** information. • **exemplify** concepts and relationships. • **analyze and decide** whether or not to **share** information with others.	• Commenting/Annotating, Widget, Alternate UI • Visualization, Syndication • Rating, Commenting/ Annotating, Recommendations
Securing Information	• **distinguish** which information is suitable to be given to outsiders and **analyze** how to ensure security (confidentially) of information. ❽ • **use** appropriate technologies for persistent storage and sharing.	• Personalization ❼ • Sharing, Personalization

Due to the limited space in this paper, a detailed description of each entry in the table cannot be provided. Thus, in the following, we will go only into some examples indicated by numbered marks. As an example, the information skill "Retrieving Information" refers to understanding which information is needed and evaluating the appropriate strategy for getting this information (❹), e.g., by using a search function. In order to acquire this skill, differentiating between relevant and non-relevant keywords (❷) is essential. This could be supported by a folksonomy (❶), i.e., a set of commonly used tags. Tag clouds also visualize relationships between tags and indicate the relevance of each tag (i.e., keyword) by its size or color. User ratings, recommendations, and comments (❸) can be leveraged by knowledge workers for estimating the quality and relevance of the retrieved information as well as the selected retrieval strategy (e.g., whether the search engine or the keywords are bad).

Summarizing information in a knowledge worker's own words and putting facts in a nutshell helps to increase personal learning. The underlying cognitive activity of ab-

straction and summarizing (❺) is supported by the syndication features of mashups. These help knowledge workers to combine and syndicate multiple sources of information in a single place (❻). In some cases, such information can be enriched and extended by the user's own annotations or documents (i.e., summaries), somewhat similar to what most people do on a paper basis. Diigo.com is an example of a social bookmarking mashup that enables users to tag and annotate websites, add them to specific topics (i.e., lists and groups), and store and share them with a group of friends. With its syndication features, Diigo.com also provides an alternate UI for consuming information from HTML pages, e.g., by extracting annotations only.

A mashup featuring personalization could allow the knowledge worker to store and retrieve user-specific information (❼). Mashups that enable knowledge workers to regulate which information is public or private also ensure protection of sensitive information (❽).

Finally, a few conclusive thoughts on how the other features could be leveraged by educational mashups: A mashup with an alternate UI to multiple search engines, for example, could provide relevant information and automatically link already stored, user-specific information to the search results (e.g., partially realized by social search engines). The "Focused View of Data" feature of a mashup could overlay only a specific extract of the overall personal content, namely only information corresponding to the search context.

5   Conclusion and Outlook

Although efficient PKM and informal learning have a significant impact on an employee's productivity, it is underestimated in many organizations. This paper describes how mashups can foster PKM and informal learning, in order to create and reuse personal knowledge and contribute to the overall corporate knowledge base.

Based on a literature survey as well as on personal experiences, this paper has shown that the seven information skills identified by Dorsey [1] (e.g., retrieving or analyzing information) can be mapped to features of common mashups (e.g., folksonomy). Nevertheless, empirical investigations in this field appear to be necessary for proving the validity. From our perception, at the moment there exist no explicit evaluations of Web 2.0 tools regarding the attainment of learning objectives or information skills in the literature. In this context, the work presented here serves as a baseline for making assumptions for future evaluations or even to set up a first set of formal hypotheses in the context of educational research and informal learning with mashups in particular. In the future, a more complete set of learning objectives has to be defined related to the information skills we presented here. In addition, it will be necessary to define ways for assessing what has been learned in order to measure the success of mashups for knowledge construction. Nevertheless, especially with respect to informal learning, any further investigation has to take into account that such learning "happens" and is mostly hidden to the learner himself.

However, a set of mashups that fosters the PKM process of a knowledge worker should support every information skill. Thus, knowledge workers need end-user friendly development tools for easily and quickly assembling individually tailored

"throw-away" mashups for designated contexts (e.g., current project). Existing mashup development tools aim at non-technical users and primarily address retrieving or organizing information [13] rather than helping people to gain new skills. Mashups applicable for PKM and informal or even non-formal learning should support a broader range of cognitive activities. Because those PKM mashups are individual to the highest degree and rarely usable for more than one knowledge worker, current mashup tool approaches are not sufficient, since they are specialized to a particular purpose (e.g., Yahoo Pipes combines feeds or Netvibes.com organizes information).

Instead of using single mashups, in the future it may be necessary to build some "meta mashups" (applications that are mashups of mashups) to fully support PKM. In addition to the building blocks described in chapter 3, Jay Cross presents further common web application features that can be harnessed for building meta mashups [14]. Future research has to investigate how to construct end-user friendly development tools that minimize the effort for building individual meta mashups. One research challenge would be to develop a method for how knowledge workers can be guided in constructing individual PKM environments and mashups (e.g., identifying the individual need, selecting sources and features, etc.).

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