Integration of E-Learning and Knowledge Management – Barriers, Solutions and Future Issues

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Abstract. The findings of the Workshop on Learner-oriented Knowledge Management and KM-oriented e-Learning (LOKMOL 2005) are summarized in this paper. The results are derived from the presented papers as well as from the moderated discussion during the workshop. First, the main barriers that have to be passed in order to integrate KM and e-Learning are discussed. Secondly, the approaches and technologies of the LOKMOL contributions are summarized and thirdly we provide issues that should be addressed in the future in order to successfully integrate KM and e-Learning.

1 Introduction

The high potential for synergies between Knowledge Management (KM) and e-Learning seems obvious given the many interrelations and dependencies of these two fields. However, the relationship has not yet been fully understood and harnessed. The Learner-oriented Knowledge Management and KM-oriented e-Learning Workshop (LOKMOL 2005) held at the Third Conference on Professional Knowledge Management (WM2005) therefore aimed at bringing together researchers and practitioners who are interested in combining findings from both fields. On the one hand, learning is considered to be a fundamental part of Knowledge Management because employees must internalize, or learn, shared knowledge before they can use it to perform specific tasks. So far, research within KM has addressed learning mostly as part of knowledge sharing processes and focuses on specific forms of informal learning (e.g., learning in a community of practice) or on providing access to learning resources or experts. On the other hand, learning might also benefit from KM technologies. Especially those technologies that focus on the support of technical and organizational components can play an important role in relation to the development of professional e-Learning systems.

The LOKMOL workshop placed a great deal of emphasis on the view that KM needs to take into account findings from the social sciences such as pedagogics or psychology, to be effective in terms of learning and that learning can profit from available KM concepts and technologies.

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2 The Workshop

A total of 32 participants from research as well as from industry from all over the world attended the one and a half day workshop. The participants' background was manifold: computer science, mathematics, as well as instructional design and pedagogics. Some of them are working in the KM domain, others are engaged mainly in the learning or e-Learning domain. Amongst all participants, about a dozen mentioned that they are working in between the two domains, i.e., not explicitly in the KM or e-Learning domain. The mix up of different interests, meanings, and expertise brought up interesting discussions. Many important findings have been gathered.

The workshop was structured in four sessions. Each session started with three short presentations and concluded in a moderated discussion. The presentations served as a good basis for the sub-sequent discussion. In addition, each discussion was motivated by prepared questions posed by the moderators. During the discussion mind maps and wall papers were used to capture the main findings. These findings are presented in the next section by starting first with the identified barriers, then with solutions presented by the authors. We conclude with future issues to be solved.

3 The Workshop Findings

As Schmidt motivated in his paper, KM and e-Learning serve both the same purpose: facilitating learning and competence development in organizations. However, they follow two different perspectives. KM is related to an organizational perspective, because it addresses the lack of sharing knowledge among members of the organizations by encouraging the individuals making their knowledge explicit by creating knowledge chunks which can be stored in repositories for later re-use or participating in communities of practice; opposed to that, e-Learning emphasizes an individual perspective, as it focuses on the individual acquisition of new knowledge and the technical means to support this construction process [12].

In organizations where KM and e-Learning systems are used, most working processes are very knowledge intensive and involve many people working at different locations and on different tasks. The context in which people are working is changing constantly through changing work processes, different tasks or problems to be solved. These facts require continuous competence development. Ley, Lindstaedt & Albert refer in their paper to recent work stating that one can differentiate between short-term performance support that would involve learning simple procedures or problem solving strategies, and long-term people development [8]. Regarding the short-term performance support, learning is often based on getting involved in communities of practice, accessing knowledge repositories in order to find suitable knowledge, or on receiving the right information for a specific situation pro-actively by the system. Learning is happening just-in-time and in context. *Just-in-time learning* can be defined as the acquisition of knowledge and skills as needed. As Bonar stated in the late 80s, learning becomes fragmented and bite-sized because of the small portions of information and learning content delivered to the learner [2]. It is obvious that a lot of information chunks are stored within the KM repositories. Hence, there are many opportunities for just-in-time learning using relatively small information chunks in the

context of use. Opposed to that from a long-term learning perspective, "people develop competencies that enable them to perform competently in a broad area range of situations" and not just for the current situation the learner is currently in [8].

Another important issue is that individuals should be able to recognize trends and to identify correlations within their daily work or the subjects they are working on [6]. Thus, different and innovative ways of learning are required, and hence a new type of learning systems.

Ley et al. mention interesting studies that show "that only 20-30% of what is being learned in formal training is actually transferred to the workplace in a way that enhances performance and that 80-90% of what employees know of their job, they know from informal learning" [8]. Does this mean hat we should focus on informal learning and reduce formal education in organizations? The following section shows that we should not reject formal education, it rather explains why learning in organizations has to follow some guidelines to make it more successful. We capitalize on the integration of KM and e-Learning as a solution for better job performance through learning.

3.1 Identified Barriers for Integration

An interview-based study demonstrated that perceived connections between KM and e-Learning are not operationalized, i.e., integration ideas are rarely implemented in practice [5]. The reasons for the so far weak integration of KM and e-Learning on a conceptual and technical level are related to several barriers that are elaborated next. They are mainly based on the written contributions to the workshop, the discussions done during the workshop and other problems identified in the literature that have not been explicitly addressed during the workshop:

1. Problems on a Conceptual Level

Ley et al. propose a division of a typical workplace into a work space, a learning space, and a knowledge space. In order to enable effective learning, these spaces have to be linked. One of the arising problems is *cognitive disconnection* between the three spaces, because "each of the spaces has an inherent structure which mirrors to some extent the mental model of the people who are using it" [8]. Benmahamed, Ermine & Tchounikine state in their work that one of the problems is to connect already available conceptual KM models to learning activities and existing learning standards such as IMS Learning Design [1].

2. Problems on a Technical Level

Each of the spaces listed above (i.e., work, learning, and knowledge space) is implemented on different technical systems [8]. Examples of these spaces include specific desktop applications, e-Learning platforms, and KM System such as the Intranet or a Wiki system. Each of these systems potentially has its own content structure, which makes the integration of the systems more difficult.

3. Problem of Neglecting Learning Processes

KM addresses learning mostly as a part of knowledge sharing processes and focuses on specific forms of informal learning (e.g., learning in a community of practice) or on providing access to information resources or experts. KM systems focus on knowledge acquisition, storage, retrieval, and deployment of knowledge. However

they do not explicitly address learning processes themselves, which is essential for effective learning and competence development [10]. In addition, Schmidt states that "KM does not fully realize that it is mainly about facilitating purpose-oriented learning in organizations" [12].

4. Problem of the Amount of Guidance Provided

As described above competency development takes mostly place during informal learning at the workplace. The learning process is characterized by self-organized activities such as selecting the environment for learning (e.g., Internet), defining learning goals (e.g., related to a work problem), finding and selecting content for learning (e.g., websites or colleagues), and following a preferred learning path. As motivated above, the competence development process largely relies on the learner's own initiative. Performing these activities requires certain skills and expertise in the domain. This is considered to be one of the main barriers for an integration of KM and e-Learning: While many KM systems provide little or no guidance to inexperienced individuals, many e-Learning courses provide too much guidance and prevent the learner from self-directed learning. They are not flexible in terms of their navigation, or content selection/hiding.

According to constructivist learning perspectives, knowledge cannot be transmitted to learners, but must be individually constructed and socially co-constructed by learners [7]. Learning systems should provide learners with a wide range of services to assist and facilitate knowledge construction, because learners may construct their own meaningful understanding of a learning theme from different paths rather than imposing them on a particular learning method. This means that the amount of guidance provided to the learner should be adapted to his/her needs and context.

5. Problem of Context Neglect

Situated learning approaches developed mainly at the end of the 1980s emphasize that a human's tasks always depend on the situation they are performed in, i.e., they are influenced by the characteristics and relationships of the *context* [3]. Because of the relation between cognition and context, knowledge and the cognitive activities meant to create, adapt, and restructure the knowledge can't be seen as isolated psychological products – they all depend on the situation in which they take place.

Schmidt highlights the problem that both KM and e-Learning have a limited and isolated consideration of context. First, e-Learning solutions often do not consider that corporate learning takes place in an organizational context and that learning goals are based on real-world needs. In addition, the author states that also the authoring process takes place (and is encouraged to take place) in the same context as the learning itself, which relates obviously to the peer-to-peer knowledge sharing philosophy where the "knowledge re-users" (i.e., the learners) also become knowledge creators. Secondly, many KM approaches neglect the fact that the delivery of information chunks does not necessarily mean that the user acquires new knowledge. In particular, if the individual's context and characteristics are ignored (i.e., his/her knowledge structures, preferred needs, and learning styles) learning might not take place at all [12].

6. Problem of Structuring and Annotating Content

Ideally, integrating KM and e-Learning also means to use all available knowledge resources in an organization (e.g., documents, humans, experiences, how-tos, process

descriptions) as learning material. This entails some difficult problems, because e-Learning in contrast to KM puts much more emphasis on delivering personalized content and exploiting relations, links and cross references existing within the learning material. This of course requires to structure the material into relatively small fragments which can then be combined into bigger objects in the preferred way. In addition to that, all fragments and combined objects have to be annotated with adequate metadata to provide information about relations to other objects, technical prerequisites, presentation style and so on. Only a small part of this work can be done automatically, most of it has to be done by hand and takes a lot of time. In a typical e-Learning scenario, most of the content is produced in advance, and the repository is usually not very dynamic. In contrast to that, content is produced all the time and often by the employees themselves in a KM scenario. This makes the process of structuring and annotating very difficult, because in most cases there is simply no time available for these tasks. A middle course, meeting the demands of both easy authoring on the one hand as well as enabling interconnectedness and personalization of content on the other hand is required.

7. Problem of Lack of Interactivity

Another barrier in the use of KM for e-Learning is the fact that information chunks in KM systems often lack interactivity [13]. Learning tasks and activities are an important characteristic of good instructional design. Engaging learners and actively involving them in the learning process often increases motivation and learning gain. However, the information chunks in KM systems are usually not designed for instruction. To be successfully re-used for learning these information chunks need to be embedded in interactive learning activities.

Another strategy to make instruction effective is tailoring of content and teaching strategy to the learner's individual needs and preferences. "The effectiveness of human tutors generally does not stem from an overabundance of training and preparation but from the tutor's ability to work one-to-one with a student, and to provide constant feedback that enables constructivist learning" [13]. However, the concept of interactivity is suffering from lack of operational definitions.

8. Problem of Dynamic Adaptation

Adaptive systems strive to monitor students and select next learning steps. In fact, Brusilovsky and Vassileva [4] distinguish between two types of adaptive course sequencing: adaptive and dynamic courseware generation. While adaptive courseware generation creates a course suited to the needs of the students based on a static student model before they encounter it, systems with dynamic courseware generation observe and dynamically regenerate the course according to the student's progress. Especially the latter type of adaptation might encounter more and more attention in the future, because it is able to adapt learning to the current context during the learning process. Thus, adaptivity might help to re-use existing information in KM systems for instruction. However, conventional e-Learning systems are usually not prepared for dynamic selection and sequencing of learning material yet.

9. Presentation of Content not Cognitively Adequate

Another important issue is that individuals should be able to recognize trends and to identify correlations within their daily work or the subjects they are working on. So far, most e-Learning systems do not support recognizing trends or correlations

between subjects. Jantke, Lunzer & Fujima emphasize that e-Learning could be much more successful by making it more cognitively adequate, entertaining, and illustrating to the learner [6].

3.2 Solutions

Several methods and approaches have been proposed at the workshop to address the gap between KM and e-Learning. While some of these approaches aim to facilitate or improve learning with KM systems, others extend learning management systems by exploiting KM technologies.

Ley et al. [8] identified competence management as a possible approach to facilitate learning with KM systems. The authors describe a framework that establishes a connection between competencies and tasks or performance outcomes. Competency development can be seen as an individually controlled learning process rather than a centrally-managed development initiative. It acknowledges the fact that organizations need to support individual, work task related learning paths, so called informal learning. The authors suggest that an environment that supports working and learning needs to take into account two aspects: First, it must provide content for learning purposes and support learners in finding appropriate content. Secondly, it has to support learning interactions, e.g., a lessons-learned meeting at the end of a project, or asking supervisors and experts for advice.

Moreover, competence management can be used for developing training paths by means of weighting training methodologies according to their potential application in order to meet defined pedagogical as well as psychological objectives [9].

Yacci [13] illustrates an approach that creates interactive instruction out of static knowledge components as often found in KM systems. Based on this approach, existing material might be augmented and reused for learning purposes. A so called *Conversational Diagnostic Agent* (CDA) provides a diagnosis, in terms of skills, that can be used by students or faculty members to access instructional resources. The CDA uses a student model that is based on a learning hierarchy, where skills are decomposed into requisite sub-skills and where relationships amongst the skills are specified.

Other approaches aim at extending learning management systems by exploiting existing KM technologies. In particular, approaches that support social and collaborative learning have been proposed. For instance, Richter, Allert & Nejdl [11] show that *Minimal Activity Plans* (MAPs) can foster self-organized learning in an organization. Those plans are described by a more heuristic description framework and have to be interpreted by each recipient. MAPs do not describe work procedures in isolation but aim to encode the meaning of the activity within the organization and enable learning by involving individuals in purposive activities.

Schmidt [12] suggests to integrate working and learning on a process level, as well as through learning management, knowledge management, human capital management, and collaboration solutions on a technical level. By the incorporation of context-awareness of employees into the design of learning solutions, learning in organizations could be improved. In particular, a learning environment should capture the learner's context and characteristics (e.g., position, role, task, prior knowledge,

goals). The environment's delivery method should take the context into account, e.g., by tailoring content for learning on demand or long term strategic learning. Finally, most resources stored in KM systems are created in context which must be considered when reusing the material for information or learning purposes.

Jantke, Lunzer & Fujima [6] proposed to integrate KM and exploratory e-Learning with so called *Subjunctive Interfaces*. Exploratory learning aims at learning experiences that offer opportunities to recognize patterns of knowledge. Subjunctive interfaces support users in this process by offering multiple enquiries in parallel. The authors demonstrated the feasibility of their approach in two kinds of domains relevant to e-Learning: dynamic simulation, where a learner may need to explore how a simulation's outcome is affected by various conditions; and information retrieval, including exploratory studies in which a student may systematically gather information from Internet sources.

Standards play an important role both in e-Learning systems as well as in KM systems, and KM technologies can support the learners' needs and individual learning processes. Benmahamed et al. [1] show that the IMS Learning Design modeling language supports an integration of learning and KM; they use the Knowledge Management Mask methodology for knowledge capitalization to design e-Learning activities. This is done by matching Mask models and the concepts of the IMS Learning Design modeling language.

3.3 Future Issues

The variety of approaches presented in this workshop demonstrates that there is a recognizable trend towards a stronger cooperation between the fields of e-Learning and KM, and that there are ways to narrow the gap between these two related fields. Such integration has the potential to dramatically change today's understanding of education towards lifelong learning, particularly when linked to contributions from dynamically changing public and organizational knowledge repositories. The contributions to this workshop showed that the integration of e-Learning and KM is more than just topic-oriented delivery of information chunks by following non-adaptive processes that are prescribed by a centrally managed learning initiative. In particular, the contributions from the workshop point to the following considerations, which in turn have implications for future research in the area:

- Pedagogical and psychological aspects as well as the adherence of the current context are considered when learning methodologies and learning content is chosen to meet certain learning objectives; an issue for the future will be dealing with imperfect and dynamic user context information.
- Learning objectives are more related to the development of competencies, which are connected to task outcomes, instead of learning specific topics; learning hierarchies (e.g., skill decomposition methods) are applied to support the connection between e-Learning and KM.
- Solutions that are developed focus more and more on facilitating self-directed and self-organized learning instead of prescribed instructions provided by the

system; competency development should be an individually controlled learning process rather than a centrally managed development initiative.

- Automatic competency profiling could be automated by using competence performance structures. Due to the fact, that these structures integrate competencies with the tasks performed, profiling can be done within the usual work processes.
- Some of the presented approaches are more flexible because they are based on heuristics instead of descriptive frameworks. Adaptation of instruction during run-time seems to be a promising approach; the concept of *Automated interactivity* is an idea that would create interactive instruction out of static knowledge components. The problem of structuring and annotating content available in a KM system to suit the needs of e-Learning could be solved by matching existing standards for KM and e-Learning.
- The requirement for more interactivity, more personalization through adaptation of delivered learning content, and more reuse of content will lead to a higher relevancy of sound Software Engineering (SE) principles, methods, and techniques: e-Learning content has to be considered more and more as *Software* due to its increasing complexity in terms of interactivity with the learner and the system, different media used, increased set of metadata, and the demand for adaptability. Since component-based SE, Product Lines Architectures, and agent-oriented SE have systemized the reuse process and have made software reuse more comprehensive, these approaches could also play a crucial role for the development of future e-Learning content.
- Other problems that remain to be solved are: How long should a system remember the context of the conversation? How long should the computer believe the evidence that a student possesses any given skill when a learning process stops and starts over time?
- New approaches should emphasize more on mapping existing well-developed KM models to e-Learning specifications and standards. This will facilitate the transformation of knowledge structures and knowledge chunks to learning activity structures and learning content.
- Finally, learning is not just enabled by providing content and using the right methods but also by enabling learning through the involvement of individuals in purposive activities and real working tasks.

The discussions and results show that the integration of KM and e-Learning will only be mastered when researchers and developers of many different disciplines work together. It is clear that we will not be able to find a final solution during the next years since the development of both KM and e-Learning systems are evolving fast and hence, a lot of new research issues will arise.

As is perhaps always the case in research of this kind, more empirical research is necessary to validate the latest developments in the field of integrated e-Learning and KM. Further workshops like LOKMOL are essential to keep the community informed about recent developments in this research field and to keep the integration process ongoing.

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