First Steps towards Personalization Concepts in eLearning

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Abstract: After years of constant progress in developing software tools to support education and training, the focus in eLearning has recently been shifted from the supporting tools towards the learning person. It has turned out that the learning success can significantly be improved if the learning content is specifically adapted to individual learners' preferences, learning progress and needs. Personalization has evolved as a promising concept to take into consideration individual needs. Due to the dynamic nature of eLearning, this paper focuses not only on static but also particularly on dynamic aspects of personalization.

1 Introduction

The added value of personalization concepts has not only been identified in research (e.g. [To02]) but also in industry. For example, during the last years several well-known research agencies like McKinsey and Jupiter (for Broadvision) have conducted studies in eBusiness applications concerning the business value of personalized content. Among others, the studies have revealed the following results ([Br02]):

- The usage rates of eCommerce sites have increased by 33% to 50%
- The costs for marketing research decreased by 78% due to better understanding of customer needs thanks to the possibility to monitor user behavior
- After a year of running a personalizing eBusiness system, the number of customers is reported to be 47% higher than before and the turnover has risen by 52%

These figures indicate that in eBusiness personalization concepts help fostering customer relationships. In eLearning applications, the provision of personalized learning content additionally reinforces learner motivation; the highest impact in terms of motivation and readiness to achieve is obtained when learners are provided with content that is highly adapted to their individual preferences and needs ([Dö02]).

With this in background, we have been developing a conceptual software architecture for a software system targeting especially at personalization in eLearning. In this paper we discuss functionalities such a system provides and outline some of the software components necessary to offer the needed functionalities. The paper presents scenarios for user interactions where it is considered to be crucial to personalize the presented information. An outlook on future work in the area of personalization of eLearning content concludes this paper.

2 A software architecture for an eLearning system

According to widely accepted definitions (e.g., [SBH01]), eLearning has many different facets, ranging from Web-based learning over computer-based learning and virtual classrooms to digital collaboration and supporting learning by doing. Some of the functionalities, which we believe a software system supporting eLearning must provide are listed hereinafter:

- Provision of access to learning resources over the Internet, corporate intranets or extranets using standard technologies of the World Wide Web (WWW)
- Access to content stored in a digital library within the organizational memory
- Enabling communication and collaboration among learners and between learners and tutors
- Pre-assessment of prior knowledge and competency level of learners and subsequent administration of learning progression, preferences and personal data of learners
- Provision of interfaces to external software systems such as authoring systems or enterprise resource systems
- Creation of new learning content and migration of content from external sources
- Management of online resources as well as non-digital offline resources

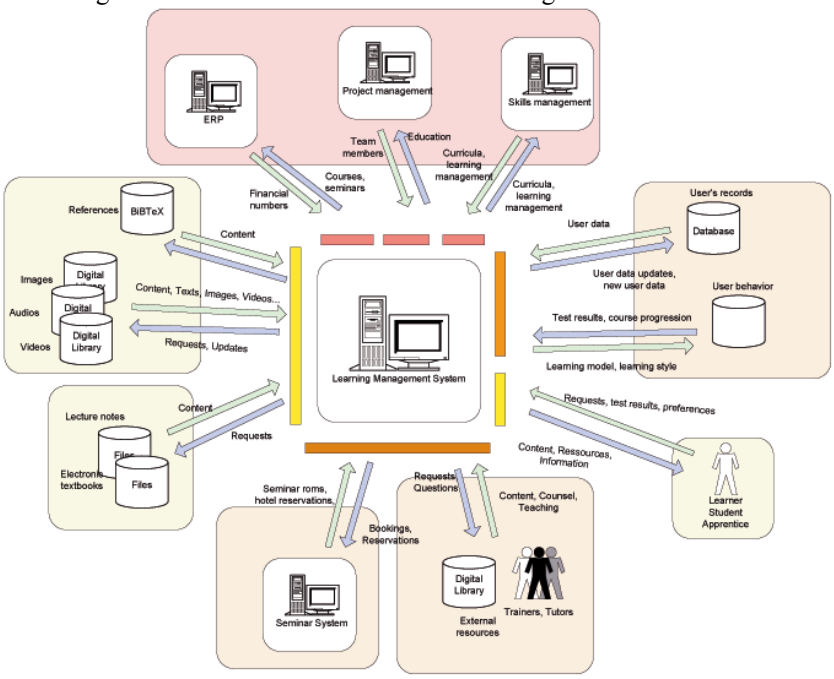

Figure 1: Software architecture of a system supporting eLearning in a corporate environment

In a software system using a software architecture similar to the one shown in Figure 1, the core of the system – the so-called 'Learning Management System' (LMS) – coordinates the flow of information and control through the overall system. Its main tasks include storage and management of course data, presenting courses to learners, provision of reports and test results and moreover interfacing enterprise systems for sharing learner data across organization-wide systems. The functionality of the core-component is enhanced by additional components

comprising among others components that manage offline resources, interfaces to enterprise data that is stored external to the actual LMS and software tools for content authoring.
In contrast to the software architecture sketched in Figure 1 there are more distributed architectures among them are the so-called *peer-to-peer* architectures. There are several models of peer-to-peer architectures: Data-centered models where data is shared among several computers across a network, compute-centered models, where complex computations and tasks are distributed among peers. The convergence of several different peer-to-peer models where software-agents arrange and manage data access, communication and collaboration among peers, will play an important role in the future ([SHDB01]). The influence of applying peer-to-peer architectures to the domain of eLearning will be investigated in our future research work.

3 Personalization

Organizational management of knowledge and eLearning are strongly connected to one another ([To02]). Especially in corporate environments, educational systems can contribute to the organizational systems to a large extent as well as benefit from them. Enterprises derive organizational knowledge from the knowledge of their employees and vice versa. Organizational knowledge is stored in so-called organizational memories. One drawback of organizational memories is that they generalize individual knowledge by providing only one internal model of the knowledge, thus losing much of the individual and personal aspects of knowledge. Another drawback is that the sheer amount of accessible information within an organizational memory increases continuously, which might lead to information-overload among learners. Hence, filtering mechanisms are required limiting the amount of presented information and shaping the content in a way that the content fits the current learner. This can be done by personalization, which is defined as the *adaptation of its systems features, the content managed by the system and its structural components for organizing content according to the internal model of reality, states and activities system users have* ([To02]).
One way to achieve this is to consider learners' competencies with respect to a certain role they have within an organization. Only information that is designed to assort with a competency profile of a particular learner is presented during learning. In [Ha01] and [LU02] some considerations concerning the technical aspects of integration of eLearning, the management of learners' competencies (sometimes also referred to as *skills management*) and strategic management are outlined.
In adaptive hypermedia systems a generic approach is used to map information content to specific users [WKD01]. The *user model* represents preferences, knowledge and interests of a particular user. The domain model describes how the information content is structured. Finally, the adaptation model defines rules that define the generation of adaptive presentations as well as updating of the user model.
Another approach to specifying the preferences, competencies and environment of a user is provided by [DA00]. Here the element *user context* is introduced to describe the information needed to characterize the current overall situation of a user. Personalized views on organizational knowledge need to strongly consider the user context.
Since a learner's user context is normally subject to continuous change, the content must be selected as close as possible to the time when it is actually needed and on a per-learner basis. The challenge from a technical point of view therefore is to construct educational content, which on the one hand optimally adapts to the learning goals of one distinguished learner and

on the other hand is created just in time, as it is needed. This form of content provision is referred to as *dynamic personalization* ([To02]).

3.1 Usage scenarios for the personalization learning content

In the following we present five different usage scenarios showing aspects of practical applicability of personalization. At first, we present scenarios where the user context is stable and does not change over time (scenarios 1 and 2). Secondly, we present scenarios for dynamic personalization (scenarios 3 – 5). In [To02] an extensive discussion of the current state of research in personalization strategies and personalization dimensions is given.

Scenario 1: Role-based compilation of learning resources
When a user incorporating a specific role works with the system, the system compiles learning resources, which have been considered relevant for the given role. A personalized view in terms of structure of the resources (links, hierarchy, sequence) as well as the content of the resources is presented. The presentation of the content in terms of the user interface (UI) follows rules that prescribe the application of UI standards to organizational roles.

Scenario 2: Static, goal-related education
This is actually a sub-scenario of the first one. Instead of an organizational role, an employee's educational goal drives the creation of content. Goals are defined during personal career interviews or as a consequence of a company's strategic orientation and do therefore not change over long periods of time.

Scenario 3: Presentation and selection of learning resources according to changing curricula
A learner accesses the system and is presented with learning content according to a curriculum that is tailored to her specific needs. The curriculum changes due to the completion of courses, new courses a learner subscribes to, courses a learner wishes to eliminate from her individual curriculum, the expiration of resources or changes in corporate educational strategy.

Scenario 4: Changes to presentation styles of content, which has already been visited
For example, a learner has completed a specific course. This course certainly does not need to be presented in full detail any more but some kind of *thumbnail* of the content may be shown to the learner. Thus, the system clearly indicates what courses a learner already has completed. This way of personalization will provide the learner with a visual impression of the overall structure of the field of studies and supports the learner in developing a cognitive model for it.

Scenario 5: Compilation of content according to test and assessment results
For example the eLearning system determines, a learner knows too little in a specific field and presents the learner with more information in that field. After a while the system will present a test to the learner, checking the learner's progress in that specific field again. Depending on whether or not the tests are successful, the system will adjust the curricula. If the learner does not pass certain critical tests a human tutor will be advised to support the learner.

4 Outlook

In the first part of this paper the necessity of personalization in eLearning has been laid out then a number of usage scenarios have been presented. The next logical step consists in developing a more formalized use-case driven system design. Before this step can actually be tackled the following key questions need to be answered in future research work:

- Are there more scenarios, which need to be considered for the targeted system? And do the scenario descriptions really describe interactions with the system as they are executed in real-world settings?
- What are possible influences of the application of different software architectures on dynamic personalization?
- How can technologies and concepts developed for adaptive hypermedia systems and generic knowledge management systems be utilized for dynamically personalizing eLearning content?

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References

[Br02] Broadvision.: Business Value Bulletin. Broadvision, 2002. Available from http://www.broadvision.com

[DA00] Dey, A. K.; Abowd, G. D.: Towards a Better Understanding of Context Awareness. In: *Proceedings of the CHI 2000 Workshop on "The What, Who, Where, When, Why and How of Context-Awareness"*. April 2000. Retrieved 2002, October 4, from http://www.gvu.gatech.edu/gvu/reports/1999/

[Dö02] Dösinger; G.: *Conceptions and misconceptions in the domain of early mathematics. An empirical approach based on the theory of knowledge spaces and information systems*. Unpublished manuscript, Graz, Austria, October, 2002.

[Ha01] Hasebrook, J.: Learning in the Learning Organization. In: *Journal of Universal Computer Science*, 7(6):472-487, June 2001. Retrieved 2002, October, 1 from http://www.jucs.org/jucs_7_6/learning_in_the_learning/

[LU02] Ley, T; Ulbrich, A.: Achieving benefits through integrating eLearning and Strategic Knowledge Management. In: *Proceedings of the International Workshop on Interactive Computer Aided Learning*, Villach, Austria, 2002.

[SBH01] Seufert, S.; Back, A.; Häusler, M.: *E-Learning – Weiterbildung im Internet. Das ‚Plato Cookbook' für internetbasiertes Lernen*. SmartBooks Publishing AG, Kilchberg, Switzerland, 2001.

[SHDB01] Sweeney, J.; Hayward, S.; Drakos, N.; Batchelde, R.: *The Five Peer-to-Peer Models: Toward the New Web*. Research Note, GartnerGroup, 2001.

[To02] Tochtermann, K.: Personalisation in the context of digital libraries and knowledge management (in German) Post-Doctoral thesis (Habilitation), Graz University of Technology, March, 2002.

[WKD01] Wu, H.; de Kort, E.; De Bra, P.: Design Issues for General-Purpose Adaptive Hypermedia Systems. In: *Proceedings of the ACM Conference on Hypertext and Hypermedia*, pp. 141-150, Aarhus, Denmark, August 2001. Retrieved 2003, January, 22 from http://wwwis.win.tue.nl/~debra/ht01/final.pdf