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An adaptive and personalized open source e-learning platform

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Abstract

This paper proposes the implementation of an adaptive and personalized e-Learning system which is based on open source software and technologies. Adaptation and personalization received very little coverage in e-learning platforms. An e-learning course should not be designed without matching students' and teachers' needs and objectives as closely as possible, and without adapting during course progression. The proposed open source e-learning system offers profiling and personalization services for the teacher and student while at the same time adapts the educational content and tools in the basis of the acquired user's profile.

Keywords: E-Learning System; Open Learning Space; Adaptivity; Self Directed Personalization; Open Source Software;

1. Introduction

Personalization and adaptivity features are necessary for the production of innovative e-Learning 2.0 systems differentiating from, the mostly used until now, static e-Learning systems. The majority of current e-Learning courses are mainly based on Learning Management Systems (LMS) that support a great variety of activities performed by teachers and students during the e-learning process. A traditional LMS offers to all it's users the same services and content, meaning that all learners taking an LMS-based course, regardless of their knowledge, goals, and interests, receive access to the same educational material and the same set of tools, with no further personalized support. Adaptation and personalization received very little coverage in these e-learning platforms. An e-learning course should not be designed without matching students' and teachers' needs and desires as closely as possible, and without adapting during course progression. On the other hand, Adaptive E-Learning Systems (AES), is a recognized class of adaptive web systems which attempt to a personalized approach to E-Learning. Profiling, content adaptation and annotation, collaborative learning are features provided by a modern AES. Nevertheless, the Adaptive Learning Systems are too focused on performing specialized functions (e.g. content annotation) and lack on overall integration and as a consequence re-use of content and services. The solution proposed is to combine the advantages of both LMS (integration, re-use and an adequate set of services for both learners and teachers served by

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one system) and AES (adaptivity and personalization). This solution will be implemented by extending the capabilities of a traditional open source LMS by adding adaptability and personalization issues.

This paper reviews at first the traditional Learning Management Systems and existing Adaptive E-Learning Systems. Secondly, the available open source e-learning platforms are being evaluated mainly studying if and in what depth adaptivity and personalization features are supported by these systems. Following this paper reviews and defines the functional requirements of an adaptive and personalized e-learning system and its basic architectural components. Combining the results of the aforementioned reviews a new open source e-Learning platform is being proposed offering profiling and personalization services for the teacher and student while at the same time adapts the educational content and tools in the basis of the user's profile.

2. Review of Learning Management Systems vs Adaptive E-Learning Systems: The Open Source Solution

Current E-Learning is mainly based on the Learning Management Systems (LMS) (Brusilovsky 2001) which can be divided to close corporate systems such as the Blackboard (Blackboard) and WebCT (WebCT) and to open source systems like the Moodle (Moodle) and ATutor (ATutor). In both cases, these learning management systems (LMS) are integrated systems that support a great variety of activities performed by teachers and students during the e-learning process. In most of cases, teachers use an LMS to develop Web-based course notes and course material, to communicate with students and to monitor and grade student progress. On the other hand, students use it for learning, communication and collaboration. As is the case for a number of other classes of modern web based systems, LMS offer their users seamless services and content, meaning that all learners taking an LMS-based course, regardless of their knowledge, goals, and interests, receive access to the same educational material and the same set of tools, with no further personalized support.

Adaptive E-Learning Systems (AES), on the other hand is a recognized class of adaptive web systems (Brusilovsky 2002) which attempt to a personalized approach to E-Learning. Current research on adaptive E-Learning demonstrate that for every function that a typical LMS performs a number of AES could be found which outperform the state-of-the-art LMS. Adaptive textbooks created with such systems as InterBook (Brusilovsky 1998), NetCoach (Weber 2001) or ActiveMath (Melis 2001) can help students learn faster and better. Adaptive examinations developed with SIETTE (Rios 1999) evaluate student knowledge more precisely with fewer questions. Intelligent solution analyzers (Weber 2002) can diagnose solutions of educational exercises and help the student to resolve problems. Adaptive class monitoring systems (Oda 1998) give the teachers a much better chance to notice when students are lagging behind. Adaptive collaboration support systems (Soller 2003) can enhance the power of collaborative learning.

The traditional problems involved in authoring adaptive learning content have been nearly resolved by the new generation of authoring tools. Authoring support in modern AES such as NetCoach (Weber 2001) or SIETTE (Rios 1999) is comparable with modern LMS. Moreover, a number of existing AES are provided with a wealth of existing or newly created learning materials, while the typical LMS expects teachers to develop all learning materials themselves. For example, ELMART (Weber 2002) comprehensively supports the most important portions of a typical Lisp course - from concept presentation to program debugging. Yet, almost 10 years after the appearance of the first adaptive Web-based educational systems, just a handful of these systems are actually being used for teaching real courses, typically in a class lead by one of the authors of the adaptive system.

Nevertheless, The problem of the current generation of AES is not their performance, but their architecture. Structurally, modern AES do not address the needs of both university teachers and administration. The first issue is the lack of integration. While AES as a class can support every aspect of web-enhanced education better than LMS, each particular system can typically support only one of these functions. For example, SIETTE (Rios 1999) is only a great system for serving quizzes, but it can't do anything else. To cover all needs of web-enhanced education with AES, a teacher would need to use a range of different AES together. This is clearly a problem for the university administration that is responsible to maintain and provide training for all these systems It is also a burden for the teacher who needs to master them all and for the student who needs to manipulate several systems and interfaces - all with separate logins – and all at the same time. E-Learning stakeholders have a clear need for a single-entrance, integrated system that can support all critical functions in one package. LMS producers have recognized this need several years ago. Just in a few years after their emergence, LMS have progressed from one-or-two function systems

into Web-based information systems that can cover all needs. The second issue is the lack of re-use support. Modern AES are self-contained systems and can't be used as components. A teacher who is interested in re-using some content which is owned and managed by the author/owner(s) adaptive content from an existing adaptive system (for example, several ELM-ART Lisp problems) has only one choice - to accept all or none of an intact system, with its specific way of teaching, thereby sacrificing his or her preferred way of teaching the course. Once one excludes the authors of existing adaptive systems who built those systems to support their way of teaching, it is rare that one finds a teacher who is willing to do that. In contrast, LMS have always supported teachers in developing their course material from various components. Modern courseware-reusability frameworks such as ARIADNE (Verhoefen 2001) extend this power by providing repositories of reusable educational objects.

The key issue is how to combine the advantages of modern AES, such as adaptability and personalization with the key features of traditional LMS which are integration, re-use and an adequate set of services for both learners and teachers served by one system). Towards this objective, the available open source e-learning platforms are being evaluated mainly studying if and in what depth adaptivity and personalization features are supported by these systems. This paper also, reviews and defines at first the functional requirements of an adaptive and personalized e-learning system. Following, Combining the results of the aforementioned studies a new open source e-Learning platform is being proposed offering profiling and personalization services for the teacher and student while at the same time adapts the educational content and tools in the basis of the user's profile.

3. Open Source E-Learning Platforms concerning Adaptation and Personalization

This section proves that existing open source e-Learning systems may have, under certain circumstances adaptation and personalization features but need extension and elaboration to acquire these characteristics. This statement is based on an evaluation of open source e-Learning platforms conducted by Sabine G. et al (Sabine 2005).

The main focus of the evaluation conducted by Sabine G. et al was on adaptation and personalization capabilities and features of these systems. Regarding the so-far e-Learning systems, adaptation received very little coverage in e-learning platforms. An e-learning course should not be designed in a vacuum; rather, it should match students' needs and desires as closely as possible, and adapt during course progression. An evaluation of open source e-learning platforms with the aim of finding the platform most suitable for extending to an adaptive one was therefore very crucial and important. The extended platform could be utilized afterward in an operational teaching environment. Therefore, the overall functionality of the platform is as important as the adaptation capabilities, and the evaluation treats both issues.

According to the study of Sabine G. et al (Sabine 2005), after a pre-evaluation phase, nine open source platforms for e-Learning were analyzed in detail. The platforms were namely Moodle, ATutor, Dokeos (Dokeos), dotLRN (dotLRN), ILIAS (Ilias), LON-CAPA (Lon-Capa), OpenUSS (OpenUSS), Sakai (Sakai) and Spaghettilearning (Spaghettilearning). Based on the same study (Sabine 2005) Moodle dominates the evaluation by achieving the best value five times. The strengths of Moodle are the realization of communication tools, and the creation and administration of learning objects. Additional strengths of Moodle are the comprehensive didactical concepts and also the tracking of data. Furthermore, the outstanding usability of Moodle leads to the maximum evaluation value in the usability category. Concerning the other platforms, ILIAS obtained the best values in the categories technical aspects, administration, and course management. According to Sabine G. et al (Sabine 2005) Moodle achieved the best evaluation values. Also the second and third rank can be assigned clearly to ILIAS and Dokeos. According to the pairwise comparisons ATutor, LON-CAPA, Spaghettilearning, and Open-USS are ranked equally at the fourth position, whereas Sakai and dotLRN are ranked last. The reason for the low ranking of Sakai is that so far only the basic features are realized. But, the quality of these features is very good.

Consequently, Moodle obtained the best results in general as well as in the specific adaptation evaluation criterion. So an extension of the selected platform in a way that the courses adapt to the unique strengths, learning objectives, knowledge levels, and learning styles of each individual learner is feasible. The functional requirements and the architecture of such a adaptive, personalized and open source e-Learning system, based on the Moodle platform, are presented in the next section.

4. An Adaptive and Personalized Open Source e-Learning System

This Section is presenting the proposed adaptive and personalized open source e-Learning system, its functional requirements and initial architecture. The system is based on international technological standards for open, synchronous and asynchronous learning (Open Learning Space) and for social networking. These technological standards and good practices are focusing on collaborative learning and self – directed personalization. They are mainly based on and take advantage of Web 2.0 technologies, social software and social networking techniques which support user participation during the interaction and production of the educational content.

The proposed architecture is transforming a traditional teacher-centric and course-centric learning environment, in which the "knowledge push" axiom is dominant, to a learner-centric and interest-based learning environment which encourages "knowledge pull".

Specifically, the proposed learning environment will support both asynchronous as well as synchronous learning via a usable and adjustable user interface. The first step is extending Moodle open source learning platform**.** Moodle is mainly used for structured educational content providing. Moodle will be upgraded to a platform supporting collaborative learning (formal and informal), collaboration through structured discussion, the efficient use and re-use of the educational material the creation and management of virtual working spaces and advanced search capabilities. In addition the platform will include knowledge discovery and content annotation features for all user and media types and will support live streaming for seminars and conferences. The new upgraded system will serve as a platform also for personal and social learning. Except for the traditional characteristics of a Course Management System provides the system will provide user-centered and personalized learning based on the individual profiles, learning styles and user preferences. The user will have the ability to control and adjust the learning process in accordance with his / her interests. As a result the platform will not only support advanced personalization but will also combine features of Web 2.0 and social networks technologies. Specifically, the platform will support:

- Informal collaborative learning using facebook like e-Learning processes.
- Collaboration support through structured discussions.
- Personalization in accordance with user needs, user learning models and user preferenes.
- Creation and management of virtual working spaces emphasizing on concept and visual mapping and conceptual representations.
- Profiling using on-line forms for acquiring user information and a profiling system for defining the user's learning model.
- Social networking capabilities.
- Blogs and microblogging (mini blogging capabilities).
- Wiki-like personal and group webpages.
- Creation of discussion groups.
- Social bookmarking, providing a method is for the users to organize, store, manage and search for bookmarks of educational resources online. The bookmarks are being shared between the platform's users.
- Content tagging especially for text, audio and video.
- Knowledge management features for efficient re-use of educational resources.
- Podcasting media files from the e-Learning system to the users.
- RSS feeds for news and announces.

In parallel, synchronous e-Learning will be supported within the framework of the proposed platform. The services for synchronous e-Learning will include capabilities for Webinars creation with streaming video, web conference applications and web broadcasting for the creation of seminars, events and workshops. The synchronous e-Learning services will also include:

- Two-way streaming for audio and video.
- Virtual class facilities.
- Answering questionnaires, multiple choice and Boolean questions during a session.
- On-line chat.
- Polls and forums.
- Electronic whiteboard.
- Video and audio recording capabilities.

Both services for asynchronous and synchronous e-Learning will be integrated in a seamless and homogenous user environment. The learning objects will be created based on international technological standards, such as Sharable Content Object Reference Model (SCORM 1.2) and will embody video conferences, interactive presentations and multimedia enriched educational content.

5. Future Work

The future work focuses on the implementation progress, deployment and evaluation. Towards these goals the Moodle infrastructure is being reinforced and extended so as to have adaptation and personalization features. These extensions are mainly created with scripting and object oriented programming languages and are further added as modules to the Moodle infrastructure. These new modules are focusing at this phase on acquiring the user profiles via on-line forms and advanced login facilities, on producing the user model and on adapting the content delivered to the user based on the specific user model.

6. Conclusion and Results

This paper reviewed at first the traditional Learning Management Systems and existing Adaptive E-Learning Systems. The conclusion of this review is that a combination of the advantages of modern AES, such as adaptability and personalization with the key features of traditional LMS which are integration, re-use and an adequate set of services for both learners and teachers served by one system is necessary so as an efficient and open learning platform to be developed. To fulfill this combination the proposed solution is to select an open source traditional LMS and upgrade its capabilities focusing on adaptation and personalization. Towards this goal, the available open source e-learning platforms were evaluated mainly studying if and in what depth adaptivity and personalization features are supported by these systems. Moodle obtained the best results in general as well as in the specific adaptation evaluation criterion. So an extension of the selected platform in a way that the courses adapt to the unique strengths, learning objectives, knowledge levels, and learning styles of each individual learner is feasible. Combining the results of the aforementioned studies a new open source e-Learning platform is being proposed offering profiling and personalization services for the teacher and student while at the same time adapts the educational content and tools in the basis of the user's profile. The proposed platform supports both synchronous and asynchronous e-Learning.

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