

Sakai CLE in Serbian Higher Education

Goran Savić, Milan Segedinac, Nikola Nikolić, Zora Konjović

Faculty of Technical Sciences, University of Novi Sad
{savicg, milansegedinac, nikola.nikolic, ftn_zora}@uns.ac.rs

Abstract - The paper presents experiences with Sakai CLE at the Faculty of Technical Sciences of University of Novi Sad. Sakai CLE has been used at the Faculty in a blended learning since 2011. Currently, 369 students are using Sakai within 4 courses. The paper analyzes the usability of the Sakai tools and their impact on the courses. In addition, two new Sakai tools developed at the Faculty of Technical Sciences are described. The first tool is developed as a support for the SCORM courses personalization, while the second one provides the semantic search of learning resources stored in the Sakai CLE.

I. INTRODUCTION

Computer-supported learning has been usually implemented within specialized software applications commonly named Learning Management Systems (LMS). Ferris and Minielli in [1] explain that LMS is a software application for creation, storage, management and using of learning resources. LMS provides an infrastructure that provides management and delivery of learning material, definition and evaluation of individual and institutional learning objectives, and learning process monitoring [2]. So far, various LMS have been developed. A list of 383 publicly available LMS (with user interface in English) is given in [3]. According to [4], among commercial LMSs most widely used are Blackboard, Desire2Learn and eCollege. When it comes to free LMSs, most popular are Moodle, Sakai and Canvas. The source code of these three systems is publicly available. Using an open-source LMS enables modifying existing functionalities and developing complete new functionalities adjusted to the educational institution needs.

This paper describes the experiences with the Sakai LMS. From the beginning, Sakai has remained on the open-source LMS market in the shadow of the more popular Moodle LMS. In this paper we describe our experiences with the Sakai LMS to show how Sakai fits the e-learning needs of the Serbian higher education.

II. SAKAI CLE

Sakai [5] is an LMS developed within the Sakai foundation that was formed by several educational institutions, commercial organizations and individuals in order to integrate independently created local LMSs into a single modern LMS. Sakai is a free and open-source system. Currently, it has two official distributions - Collaboration and Learning Environment (Sakai CLE) and Open Academic Environment (Sakai OAE).

Sakai CLE is a content management system which provides various specialized e-learning tools. Apart from e-learning purposes, it may be used for collaboration in

general. Sakai OAE provides a personalized learning environment organized as a social network. The system encourages establishing a user community for creation, sharing, using and evaluation of learning material. Regarding the implementation, Sakai is implemented using Java technologies.

This paper analyzes Sakai CLE. As we mentioned above, Sakai CLE provides creating web pages containing a specific set of Sakai tools. The Sakai tools are independent components that encapsulate specific functionalities and interact with a user. There are three main categories of tools in Sakai: learning tools (learning resources management, online exams ...), administration tools for teachers (grading, calendar, student management) and collaboration tools (DropBox, chat, forum ...).

Sakai CLE is accessible by registered users only. There is a separate account for each student and teacher. Users participate in courses with different roles. User may be an instructor, a teaching assistant or a student in the course. An instructor manages users and content in the course. Teaching assistant is allowed to manage content in most course sections. Student may access learning material and create content using tools designed for students. E.g. he/she may post messages on the forum, upload files in the drop-box section, edit wiki pages etc. In addition to these three user categories, there is an administrator as a super user who may access whole content and functionalities in the system.

Beside web pages containing e-courses content, for each user there is a separate set of pages that represent his personal workspace. The workspace may contain tools for the administration of user's personal data, tools related to some course-independent Sakai functionalities and tools that provide a centralized access to data from all users' Sakai courses.

III. SAKAI AT THE FACULTY OF TECHNICAL SCIENCES

Sakai CLE ver. 2.7 has been used at the Faculty of Technical Sciences (FTN) at the Chair of Informatics from February 2011 (hereinafter FTN Sakai). FTN Sakai is publicly available at the internet address [6]. So far, 4 courses have been set on the FTN Sakai system. 369 students and 5 teachers have participated in the courses. Table 1 presents the details about the courses in FTN Sakai.

Presented courses have been used in a blended learning environment as a support for the traditional face-to-face learning on the Faculty. The home page of the Web programming course in FTN Sakai system is showed in Figure 1.

TABLE I.
FTN SAKAI COURSES

Course	Study program	Semester	No. of students	No. of teachers
Web programming	Computers and automation	VI	328	3
Web programming	Software and information technologies	III	41	1
Platforms for object-oriented programming	Software and information technologies	III	41	1
Web design	Software and information technologies	IV	41	1

IV. FTN SAKAI EXTENSIONS

Beside the tools that are parts of the standard Sakai distribution, FTN Sakai has been extended with two tools developed at the Faculty of Technical Sciences.

As mentioned, Sakai source code is publicly available. The code has been written in Java programming language and organized in more than 80 projects for Eclipse IDE [7]. Sakai system runs on the Apache Tomcat web server and uses MySQL database management system. Regarding presentation layer, different front-end technologies, such as servlets, Velocity, JSP and JSF are used.

A. Sakai tool for the SCORM courses personalization

First tool has been developed as a support for the personalization of SCORM courses. Learning material in SCORM-compliant courses has been personalized based on student's learning style. Learning style has been defined according to the Felder-Silverman model of learning styles. In this model, student's learning style can be determined using the Index of Learning Styles (ILS) questionnaire. Personalization principles are described in detail in [8].

We extended Sakai system with a tool that generates a personalized SCORM course for each student. The tool contains a module for determining student's learning style. The module has been implemented using JSF technology. Within the module, a student can fill out an ILS questionnaire. The module contains three web pages

for displaying all completed ILS questionnaires, filling out a new questionnaire and displaying questionnaire results, separately. A newly created web page for filling out an ILS questionnaire is shown in Figure 2.

After completing the questionnaire, the student's learning style is calculated. Figure 3 shows our page for displaying the results of an ILS questionnaire.

As mentioned, the personalization is done on SCORM-compliant courses. Standard Sakai distribution doesn't contain a tool for working with SCORM-compliant courses, but there are few third-party tools for this purpose. In our FTN Sakai extension, a SCORM tool developed by the UC Davis University [9] has been used. We have integrated previously described personalization mechanisms into this tool. Hence, in the FTN Sakai system, the UC Davis SCORM tool displays SCORM courses personalized according to the results from the ILS questionnaire. The personalization process and the screenshot of the personalized web programming course in the UC Davis SCORM tool is shown in Figure 4 (learning material in the course is in Serbian).

The quality of the personalization highly depends on metadata that describe learning resources. A teacher defines metadata during a course creation phase. XML syntax, used for specifying resources and their metadata, is primarily a machine-readable format. Teachers without

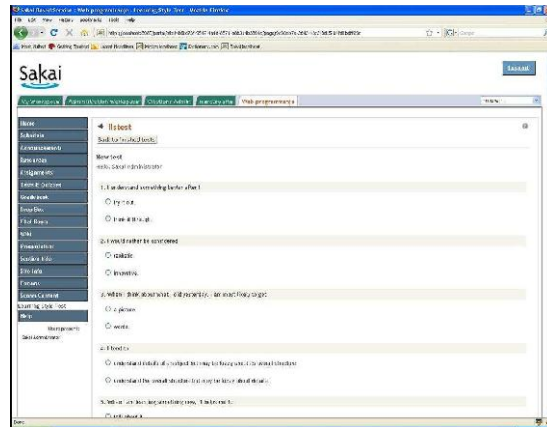


Figure 2. Filling out a new ILS questionnaire in the FTN Sakai extension for SCORM courses personalization

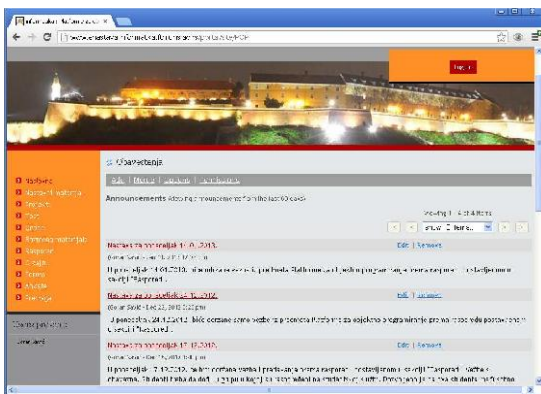


Figure 1. Web programming course in FTN Sakai

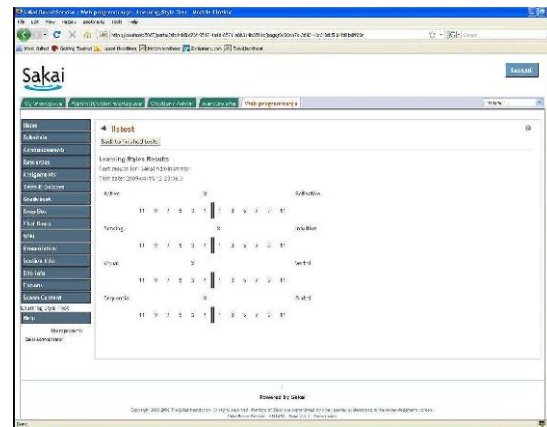


Figure 3. Displaying the results of an ILS questionnaire in the Sakai FTN extension for SCORM courses personalization

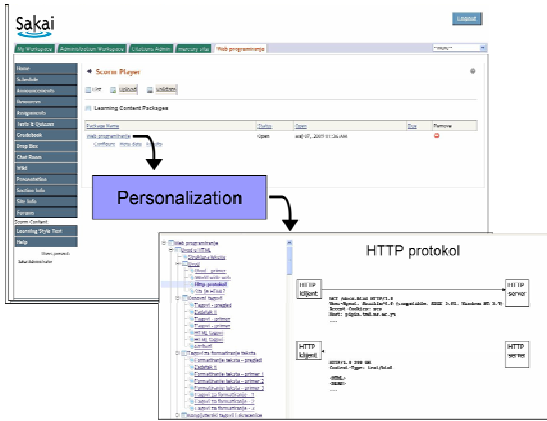


Figure 4. Filling out a new ILS questionnaire in FTN Sakai extension for SCORM courses personalization

specific technical knowledge may find it difficult to define resources' metadata. To facilitate specifying metadata, we have created a new page within FTN Sakai system. The page displays resources graphically in a form of a tree. Next to the resource, its metadata are displayed. This page is shown in Figure 5.

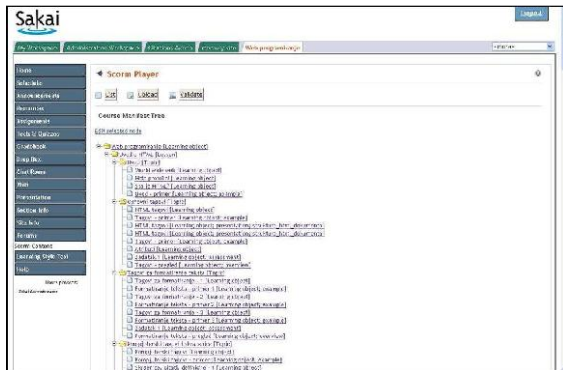


Figure 5. Web page for displaying resources in a FTN Sakai SCORM course

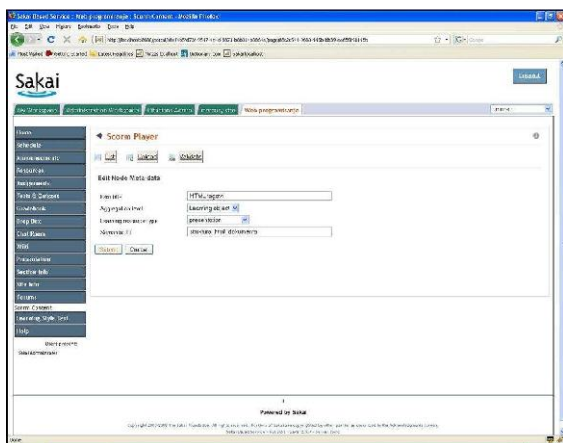


Figure 6. Web page for editing resource's metadata in a FTN Sakai SCORM course

Beside the page for displaying metadata, we have implemented a support for editing of metadata on a separate web page. Figure 6 shows a screenshot of this page.

B. Sakai extension for the formal representation of learning goals

Second extension developed within the FTN Sakai system is related to the representation of the learning goals in a Sakai course. Further text gives a brief description, while all details are presented in [10]. Standard Sakai distribution contains a tool named Syllabus intended to describe the course structure. We may consider this structure as learning goals that should be achieved in the course. The *Syllabus* tool represents learning goals as a free text. Such representation is not appropriate for machine processing. To overcome this constraint, we have developed a new tool for representing learning goals in the FTN Sakai system. The new tool provides machine-readable description of learning goals in a course. As formalism, we have used the ontology described in [11] and [12]. We have modified Sakai Resources tool (which provides learning resources management) to enable linking learning resources to formally represented learning goals. The extension incorporates a new metadata field in the metadata set of the learning resource. This new metadata field defines a learning goal related to the learning resource. Figure 7 shows a page for displaying resource metadata extended with a new textbox field for entering a corresponding learning goal.

Incorporating machine-readable representation of learning goals has enabled the implementation of new features in FTN Sakai. We have added two more actions for the selected learning resource which provides finding similar resources and finding precondition resources, respectively.

To achieve a specific learning goal, a student consumes a set of learning resources related to this goal. We use the term "similar resources" for all resources designed to

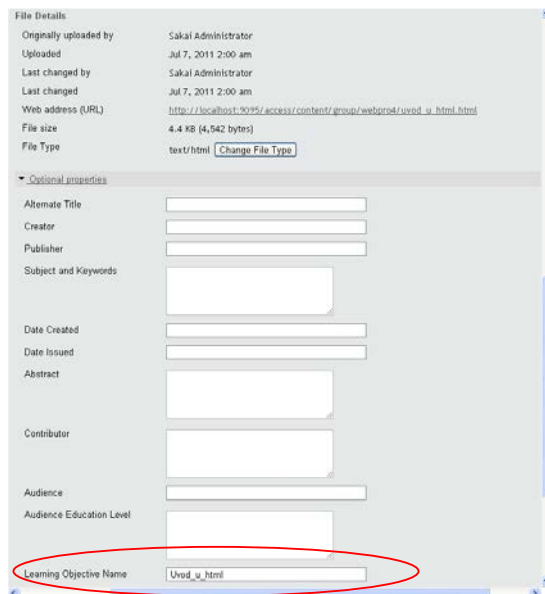


Figure 7. Defining a learning goal related to the learning resource in FTN Sakai

achieve the same learning goal. In FTN Sakai, we have extended the Resources tool, from the standard Sakai distribution, to support finding similar resources for the selected resource. Figure 8 shows a newly created page for displaying all learning resources similar to the resource “CSS pre-test” in the Web programming course.

Achievement of a specific learning goal implies usually some prior knowledge. We have extended Resources Sakai tool to provide finding all learning resources that should be studied before the specific resource. We refer such resources as precondition resources. Precondition resources can be found by exploring the ontology of learning goals previously stored in FTN Sakai. The ontology contains the “is-precondition” relation. This relation between two learning goals implies that first learning goal should be achieved before the second one. For the selected learning resource, its precondition resources are all learning resources related to a learning goal which is a precondition for the learning goal related to the selected resource. Figure 9 shows precondition resources for the resource “HTML tables” in the Web programming course.

So far, described extensions have been used as a part of the scientific research only. The extensions have not been used in the courses officially and they are not deployed on the publicly available FTN Sakai server.

V. EVALUATION

This section analyzes benefits of using FTN Sakai in teaching at the Chair of Informatics. Beside the Sakai system, the MoinMoin [13] software platform has been used as an environment for blended learning at the Chair. MoinMoin is a generic content management system based on wiki pages whereby we use it for the administration of

course content. For each course, a set of wiki pages containing course announcements, assignments and learning material has been created. In contrast to Sakai, MoinMoin doesn't provide specialized tools for course administration, so course content is administered by editing wiki pages. Since there is no integrated wiki editor in MoinMoin, a user must be familiar with wiki syntax to be able to edit wiki pages.

MoinMoin has been primarily used as a repository of learning material. As previously mentioned, the most frequently used Sakai tool is the *Resources* tool for the administration of learning resources. Since Sakai has been also primarily used for sharing learning material, it has not brought significant improvement of the teaching practices established within MoinMoin platform. Migration to Sakai has not shifted a focus of the teaching scenarios, since the focus has stayed on the learning resources retrieval.

Although Sakai has been mostly used for the learning resources management, it is still more comfortable software environment than MoinMoin platform, since it provides specialized e-learning tools. Also, it is relatively easy to train new Sakai users because they do not need to learn wiki syntax like with MoinMoin. Still, we should mention that the version 2.7 of Sakai CLE relies on the web 1.0 technology, which implies some constraints regarding the user experience. Sakai 2.7 tools do not use Ajax technology to communicate with the server which makes content displaying slower than it might be.

Concerning the other tools in FTN Sakai, DropBox tool has simplified the communication with the students. This tool has provided a centralized repository for sharing learning material between teachers and students, which has made it easier for a teacher to monitor students' engagement in the course. Regarding Forum, as another tool used for the communication between course participants, it has been used very rarely. The reasons may be different, but we assume that social networks are nowadays a common environment for the electronic communication between students.

VI. CONCLUSION

For sure, Sakai CLE has improved learning technologies at the Faculty of Technical Sciences introducing more flexible tools for sharing learning resources and communication between teachers and students. Also, Sakai's architecture is extendable which allows us to implement two new Sakai tools to meet e-learning needs in our institution.

Still, current Sakai tools lack of quite old fashioned user interface and obsolete implementation technologies. Moreover, the future of the whole Sakai project is uncertain. The University of Michigan and the University of Indiana as a two founder-institutions drop out the project last year and they will not participate in the project development anymore.

All these reasons led us not to choose Sakai as a long term e-learning solution in our institution. Currently, we are migrating our e-courses to the Canvas LMS which seems to be a new raising star on the e-learning sky, providing large set of functionalities mixed with an attractive and easy to use user interface.

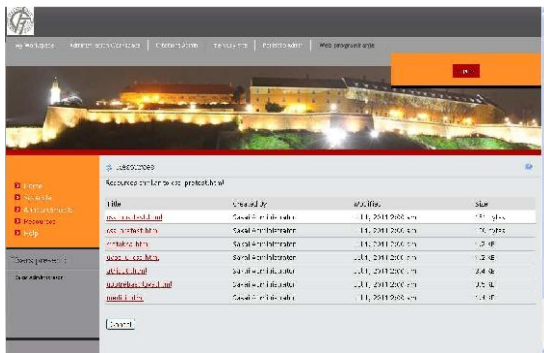


Figure 8. Web page for displaying similar resources in FTN Sakai

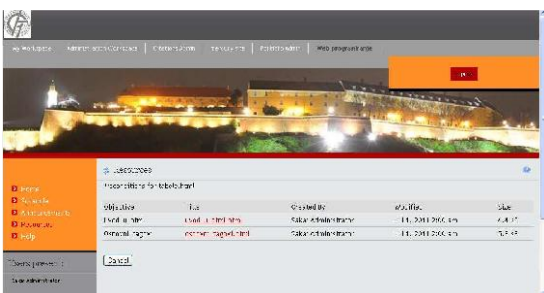


Figure 9. Web page for displaying precondition resources in FTN Sakai

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