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Automation of User Access Control Processes on the Educational Portal of Voronezh State University Based on Moodle E-learning System

Alexander Tolstobrov, Andrey Vasilev

Faculty of Computer Sciences, Voronezh State University, Voronezh, Russia

Email address:
tap@vsu.ru (A. Tolstobrov), vasiliev@vsu.ru (A. Vasilev)

Abstract: The article considers the issues of integration of the "Electronic University of VSU" educational portal (basing of Moodle e-learning system) with the educational process management information system of the university. The purpose of this is to automate the services on linking e-learning courses with the disciplines of curricula of educational programs, subscription of students to e-learning courses and unsubscribing from them at the end of their studies, and also retrieving account authentication data for all users of the portal-teachers and students. A large number of students and training courses determine the high workload of the portal users, including administrators. To address this, several software modules interfacing the Moodle system were developed. Among them are the module that allows an e-course teacher to link their course to one or more specific disciplines of actual curricula of the university's educational programs. Another one is the module of automated student group registration and their subscription to the corresponding e-courses, which implements services to automate the creation of accounts for students and subscribe the authorized students to the e-courses of their educational programs. The module that provides the service of unsubscribing from the e-learning course for students who have completed the course is also described. Finally, the module that automates processing of users' requests related to their problems with access to the portal. This service is designed to ensure that all the manipulations on the registration of students and subscription of students to the courses are carried out by persons in charge of electronic courses without the need to address them to the staff of deaneries and portal administrators.

Keywords: Electronic Training, Remote Educational Technologies, Systems of Electronic Training,
Learning Management Systems, LMS, Moodle, Processing of Incidents, Management of Access,
Integration of Information Systems

1. Introduction

As a platform for the electronic educational environment, Voronezh State University uses the "VSU Electronic University" educational portal [1] based on the world-popular Moodle e-learning system [2, 3]. This electronic learning system provides broad potentials for the creation and operation of electronic training and methodological complexes in the educational process, for the university's educational program disciplines. Today, the university portal offers several hundred electronic courses and has already registered more than 20 thousand users – teachers and students.

The Moodle-based web portal implements a developed system for managing electronic courses, registering users and controlling their access to the site resources. However, the already substantial and growing number of the university portal users and the ever-increasing number of electronic courses and other educational resources located on it generate a series of problems that make it difficult to efficiently make use of it [4].

2. Problem Definition

The following issues are relevant.
1. The necessity to link the electronic resources located on

the portal to the curriculum disciplines of the educational programs offered in the university. The problem is that, in general, a certain course created on the VSU educational portal can provide the educational process for not just one but several similar or close disciplines falling within the curricula of different educational programs.

2. Labor intensity of mass operations for registration of students on the portal, providing the students with access to the electronic courses meant for them, and other portal resources, in particular, granting them the rights to allocate their graduation qualification papers on the portal, and performing mass operations for unsubscribing the students from the courses when they finish respective studies.

3. Labor intensity of operations for servicing the flow of the students' inquiries associated with their failed (due to various reasons) attempts to access the portal resources (forgotten login/password, changed mail, etc.), and for servicing the flow of requests from the teachers and university employees for access to the portal resources, namely electronic courses and repositories of the training process documents (work programs of disciplines, curricula, basic educational programs, self-exam reports, etc.).

3. How to Create Services to Control Access of Portal Users

The urgency of the above problems necessitated the creation in the portal of additional services for portal administrators, teachers, and students, which allow automating the multiple access control processes. To effectively resolve this, it is expedient to interface the Moodle educational portal with VSU Information System, whose database now provides the necessary information about the educational programs of the university, curricula, and groups of students following them [5, 6]. This information system is based on Oracle DBMS and implements business processes for development and support of educational program curricula, computation of the academic load by training units, and managing the groups of students following the educational programs.

The solution for this problem is facilitated by the fact that the modular structure of Moodle system and the open code of its software in PHP language make it possible to solve the problems of expanding this system's functionality without modifying the program code of the system core, through developing and connecting additional plug-in modules [7, 8].

In the process of solving this problem, several modules have been developed that solve certain subproblems [9, 10].

3.1. Module for Linking Electronic Courses with Curriculum Disciplines

This module implements a service that allows a teacher who is the author of an electronic course placed on the Moodle portal to link his electronic course to certain disciplines of the current curriculum within VSU educational programs, under which the training is carried out in the current academic year.

Generally, an electronic course created on VSU educational portal is usually meant for providing a training process for several similar or close disciplines falling within different curricula of several educational programs. Unlike in the solution when each electronic course strictly corresponds to a certain discipline, this allows avoiding duplication of the same teaching materials in different courses, while significantly simplifying the teacher's task of maintaining these teaching materials and the electronic course as a whole in the up-to-date state.

The created service aims at providing the user with convenient online access to the information from the curricula base for selecting the necessary data about disciplines to choose and then link these disciplines to a certain electronic course. The service is meant for these operations to be performed beyond the portal administrator, independently by the teacher who develops and uses a certain electronic course.

In order to perform the necessary actions for linking the disciplines to the electronic course, the teacher, having logged in the course page, uses the interface of block "Curricula and students" (Figure 1) built-in the course page.
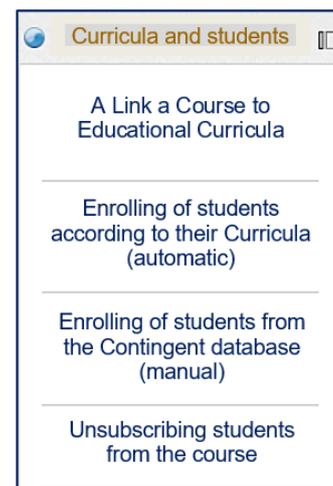

Figure 1. Block of the modules of additional services, which is built in Moodle course page.

Through it, he can use the screen form that provides the opportunity to select appropriate educational programs and disciplines within their curricula (Figure 2).

In this form, the teacher specifies the attributes of the respective curriculum: faculty, education degree (bachelor/specialist/master), code and description of specialty/field of educational program, specialization, mode of study, and then selects, from the drop-down list, the code, and name of the discipline the electronic course should be linked to.

It should be noted that the information reflected in the form is directly selected from the Oracle database of the Information system for curricula support and workload computation, which ensures the relevance of the data being

selected.

When the "Add discipline" button is pressed, the selected

discipline with its attributes selected from the curriculum is added into an electronic course Card (Figure 3).

Figure 2. *Screen form for linking the course to the curricula disciplines.*

Figure 3. *View of an electronic course Card on the portal.*

As shown in Figure 3, the card contains and shows the user the additional information on the educational program selected from the curriculum database, under which the curriculum is carried out, as well as the additional information on the chosen discipline – semester, academic assessment form, and number of academic hours by the types

of training works performed within this discipline.

We should also note the following circumstance. In a real educational process, educational programs curricula are not "frozen" documents. They are reprocessed and updated on a regular basis. In this connection, the Information system simultaneously provides information on curricula relevant to

different academic years. Using the described service, an electronic course is linked to the disciplines of the curriculum relevant to the current academic year. At the same time, the system also traces the relevance of the previously performed (for example, in the previous academic year) linkage of the electronic course to the curriculum and, if a more recent curriculum is found in the database, signals the course curator about the need to relink that course to the up-to-date curriculum.

3.2. Module for Automated Group Registration of Students on the Portal and Their Enrolling for the Courses

The developed plug-in module implements services to automate the creation of accounts for students not yet registered on the portal and subscription to a certain electronic course for students already registered on the portal, who currently study the relevant disciplines of the educational programs this electronic course is linked to (see the previous module) [9, 11, 12].

The service ensures that all manipulations associated with the building of an application for registration and subscription of students are carried out by the developer of the corresponding electronic course.

During the electronic application form building, the list of students who are eligible for registration in the portal (pending the subscription for the corresponding electronic course) is automatically selected from the Oracle database of the Information System of Student Group Management. This auto-generated list includes those who study the program that has the electronic course linked by corresponding discipline.

Figure 4. Working with the list of the students being registered and subscribed to the course.

The module-generated list of students, when necessary, can be edited by the teacher (as to exclude certain students from it) and then automatically included in the electronic application being formed, which then also automatically goes to the portal administrator for processing.

Further automated processing of student entries included in the electronic application consist of the following.

1. If the student included in the application is already registered on the portal, that is, he already has a personal account (login and password), then this student also receives the right to access this course, determined by the user's role "Student".

2. If the student included in the application does not yet have an account, then registration as a new user on the portal is performed first. And the student is assigned a personal account (login and password) to be used for the user authorization on the portal. Then the right of access to the electronic course specified in the application is granted, determined by the user's role "Student".

When one selects a link to the module of automated formation of the list of students to be subscribed to the course according to their educational programs (in the developed block "Academic plans and students" (Figure 1)), the interface of the module displays a form with links to the disciplines of curricula of educational programs, to which this electronic course is linked. When a link to the name of a particular course discipline is selected in this form, brief information related to this discipline is displayed, which is selected from the respective curriculum; also the list of

itemized links to academic groups of students who should study this discipline in this academic year (semester) in accordance with the curriculum is shown. Clicking on the name of the group opens the list of students in this group, selected from the database of "Contingent" Information System (see Figure 4).

In the list of the opened group of students (Figure 4), the teacher should mark the students to be included in the electronic application for enrolling in the course. Within the list, it is also possible to enter student ID card numbers that are not included in the database for some reason. The information about the student ID card number is required when creating a user account because this number becomes the student's login.

Automatic processing of the students marked in the list involves checking the availability of the student's account, the student's registration on the portal, if he or she has not already been registered, and further enrolling the student in an electronic course with the access rights determined by the user's role "Student".

After the application is processed, in the list (Figure 4) of the students enrolled in the course, instead of a checkbox, an icon will be displayed indicating that the student has subscribed for the course.

In some cases, it is necessary to enroll the students following the educational programs that are not linked to this course, using the service discussed above. For example, when the student follows an individual plan, or in other cases when the database of the "Contingent" system for some reason contains no linkage of the students to the educational program the course belongs to.

Another student entry service is meant for this purpose, which is also accessed by selecting the respective item in the developed block "Curricula and students" (Figure 1), "Entering students from database "Contingent" (manual)".

Selection of this item opens a form for entering the parameters for choosing the students from the "Contingent" database, namely:
1. faculty,
2. entrance year,
3. mode of study,
4. education degree,
5. field/specialty.

After setting up the student selection parameters, the lists of students selected from the database by academic groups in accordance with the specified selection condition are uploaded into the form.

Note an important circumstance pertaining to the registration of students and their subscription to courses. A compulsory condition for the students' registration and enrolling in a course is that they have student ID card numbers. This number becomes the student login. The student ID card number is selected from the database of Information System "Contingent" and is specified in the list of students shown in the form in Figure 4, in brackets, next to the student's last name, first name, and patronymic. However, sometimes, the database might for some reason include

students whose student ID card number is not specified. When the student ID card number is not found in the database, in the list shown in Figure 4, next to the student's full name, a line is displayed where one can manually enter the required number.

The students to be enrolled in the course are marked with a tick on the list. After that, the "Send Application" button is pressed to send the electronic application to the administrator.

The portal administrator can monitor the student registration applications awaiting processing in the "Submitted Applications" administrative block section. The form opened by this link displays the application number, its status, and the number of students wishing to enroll. In this case, the administrator just approves or rejects the submitted application.

3.3. The Module for Unsubscribing Students from the Course

An important service also provided by the developed program block makes it possible to automatically unsubscribe students from an electronic training course. The teacher usually carries out this operation after the students have finished their studies in this course. It should be noted that unsubscribing a student from a course does not imply removal from the system database of the information about the academic achievements of this student during the course. All this information is stored in the portal database. If necessary, one can access the information about the student's activities in this course by subscribing the student to this course once again.

The student unsubscribing service in the "Curricula and students" block (Figure 1) is accessed by the "Unsubscribing students from course" link. After that, the course page displays the itemized links with the names of groups of students enrolled in the course. The selection of these links opens the lists of students belonging to the respective groups. The students to be unsubscribed from the course are marked with a tick in that list. The teacher, for example, may decide not to unsubscribe the last year's students who have arrears in this course.

After pressing the "Unsubscribe" button, the marked students will be excluded from this course.

3.4. A Service for Automated Handling of User Requests Related to Issues with the Access to the Portal

The educational portal experience has shown the urgency of the problem of handling the flow coming from the users (especially students) and the requests to the portal administrator associated with the users' failed attempts to access the portal resources. The causes of such situations, which are unfortunately quite frequent due to a large number of portal users, can be different. This may be a trivial reason like "I forgot my login/password". Or it may be the impossibility for the student to use the standard Moodle service "Forgot your password?" because it was not specified

at the first login, or the previously specified e-mail address was changed. Access to the site can be denied because the student does not have an account; for example, when a teacher uses the group registration service described above and subscribes students to courses, and a certain student appears to be still not registered on the portal, because the database does not contain information about this student's ID card number, according to which the login is generated (such a situation may happen for some categories of students). Finally, cases are possible when a student is denied access due to errors in his or her personal data in the database.

In order to find out the reason why the student was denied access to the portal, and to solve the problem, the portal administrator usually needs additional information from the user about the essence and circumstances of the problem, which, unfortunately, is usually missing from the letters of the users asking for help. The portal administrator needs additional correspondence with the user to obtain the necessary information from this person and to further access the information from the user accounts database and the student entries database of the Contingent management system, which are the factors that impede the prompt solution of the problem.

The key points of the suggested solution for remaking the Moodle portal standard service meant for the restoration of the account information, are as follows [13, 14].

1. Generating the "I cannot enter the site" electronic inquiry, ensuring the reception of all the data necessary to solve his problem.
2. Confirmation of authenticity of this information, for which purpose the student attaches a file with a scanned or photographical copy of his or her student ID card to the inquiry.
3. Subsequent use of the obtained data for automated identification and user authentication through the user accounts database and the student entries database of the Contingent management system; and then, recovery or creation of a new account, even if the databases do not contain the identification attributes such as e-mail address or the student ID card number.

When handling the inquiry, the personal information presented in it is compared with the values of the respective fields in the user profiles registered on the portal, and the student entries fields in the database of the Contingent management information system. The data set provided by the student is enough to uniquely establish the presence or absence of the student's account in the portal and to identify the entry pertaining to this student in database "Contingent", even if the account misses the student's e-mail address and the database "Contingent" misses the student ID card number. This allows one to automatically, virtually beyond the portal administrator, diagnose the reason for the access denial, correct the wrong and/or missing data in the user profile, if necessary, send the user an e-mail about restoring access and about the actions that he or she should carry out, or a message explaining the reasons for the access denial (for example, the values specified in the inquiry do not match the

ones in the database).

4. Conclusion

The software modules (plugins) presented here were implemented in PHP language and connected to the Moodle software portal "Electronic University of WSU" (edu.vsu.ru) [1]. They provide the integration of the portal with the information system of the university, complementing the functionality of Moodle system. The active use of them confirmed the correctness of the chosen approaches to solving really pressing problems of practical use of the excellent e-learning system Moodle.

The effect of the implementation of the developed software modules is largely determined by the approach in overcoming the difficulties that arise in real life activities of a large number of participants in the educational process in the environment of the e-learning portal: that is, the implemented functionality is naturally combined with the specifics of the activities and competences of academic personnel without the usual need of support or maintenance personnel involved.

The function of linking an e-course with specific disciplines of educational programs is quite natural for a teacher who is authoring the e-course. In addition, eliminating the need for IT or other auxiliary staff as part of a straightforward workflow makes it easier for teachers to support the lifecycle of an e-learning course.

The services that provide integration of the portal with the information system of students' contingent management and planning of the educational process fundamentally simplify the task of mass registration of students on the site and their subscription to electronic courses before each academic year or semester, as well as their unsubscribing from the courses at the end of training. This service currently provides teachers with easy access not only to the database of students, but also to lists of academic groups of students to subscribe to the course, which are automatically formed in accordance with the disciplines related to electronic courses of the curriculum of the next semester. Simplicity and convenience of using the implemented services of students' subscription to electronic courses and their unsubscribing from the courses allowed delegating this function directly to the teachers of electronic courses, completely freeing them from the need to ask for help for these purposes to the services responsible for managing the contingent of students and planning the educational process, and, moreover, eliminating the need for their possession and use of low-level Moodle administrative functions (for personal registration of each student and his admission to the electronic courses).

Finally, the creation of the automated service presented above in 3.4 has allowed to solve problems of service of the mass inquiries of users connected with problems of their access to resources of a portal arising for various reasons. This includes the need for students to obtain credentials for the first login to the site at the beginning of the academic year, and the need to process quite an intensive flow of incidents related to recovery requests lost for a variety of

reasons of credentials. The task of maximum automation of processing of such requests was solved, allowing not only to minimize the need to involve administration team of the site and the accompanying mutual email correspondence, but more importantly, to dramatically improve the efficiency of dealing with these issues.

Thus, the created and practically tested software modules integrated into the Moodle e-learning system allowed to significantly improve the comfort of its users — teachers and students — in the electronic educational environment implemented by this outstanding system.

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