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AN APPROACH TO IMPLEMENTATION OF BLENDED LEARNING IN A UNIVERSITY SETTING

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Abstract: In this paper we present an approach to introducing modern computer-mediated activities in course instruction at the Faculty of Mining and Geology - University of Belgrade, as a complementary approach to traditional face-to-face instruction. The initial platform for this blended learning approach was an in-house solution which has been successfully used for several years. From the academic 2010/11 year the approach was further enhanced by a gradual introduction of the open-source Moodle platform. Depending of the nature of specific courses, other software tools are also becoming part of the instruction process, especially for ICT oriented courses. We illustrate our approach on the example of the undergraduate course Informatics I and the postgraduate course InfoTeh.

Keywords: E-Learning, Course Management, Blended Learning, Moodle

1. INTRODUCTION

The role of ICT in education is growing substantially, whereas its application tends to take more and more diverse forms. Within the concept of e-learning, which can most broadly be perceived as comprising all forms of learning and teaching supported by electronic devices, the opportunities offered by Internet and Web are now prevailing. Hence the term Web-based learning or Web-based education is now also frequently encountered. This concept encompasses all aspects and processes of education that use WWW as a communication medium as well as its supporting technology [1]. Within the interaction of ICT and education many other terms, such as online education, virtual education, Internet-based education, and education via computer-mediated communication are also being used [2].

Due to the impact of ICT-based learning tools, particularly those based on the WWW, traditional face-to-face instruction is being seriously challenged. However, it is safe to say that the role of instructors in an ICT supported learning environment has not lost its importance, but rather that their approach to instruction, and their obligations and responsibilities are undergoing a substantial change. The approach that combines elements of traditional and e-learning paradigms, which is thus hybrid in its nature, offers a great extent of flexibility in applying ICT to learning, and often goes under the name of blended learning [3].

For several years now, computer-mediated activities in the learning process have been gradually introduced within the Faculty of Mining and Geology (FMG) - University of Belgrade, as complementary to traditional face-to-face instruction¹. The approach, which could be classified under blended learning, gradually evolved. Namely, the initial blended learning platform was developed as an in-house software solution, but starting with the academic year 2010/11, the open-source Moodle (Modular Object-Oriented Dynamic Learning

Environment) platform was also introduced in the process. Finally, depending on the nature of the courses offered at FMG, other software tools are also being used in the learning process, especially within ICT oriented courses. The current state of the blended learning approach at FMG will be illustrated by two courses, one offered to students of undergraduate studies and the other to students at master and doctoral studies.

The main motivation for introducing a blended learning system came from the fact that in traditional face-to-face learning, the students were prone to taking a basically passive role. Thus the new learning system was aimed at turning the student role in the learning process to a more active one, and enhancing their participation in practically oriented teaching activities in particular. Introduction of the blended learning system at FMG was feasible due to the fact that the faculty disposed of sufficient computer and human resources to support this form of teaching.

An important motivating feature of blended learning and the supporting tools is the possibility of a day-to-day insight into the progress of students during the semester by both teachers and students themselves. Bearing in mind that their activities and results are being regularly monitored, the students are motivated to try harder and follow the activities within courses regularly and more attentively than in the traditional organization of instruction.

As of last year, the focus of the development of our blended learning environment is on the well known and widely used open-source Moodle platform. However, we shall also offer an insight into other technologies that have been used to support the teaching process at FMG, starting with an outline of FMG CMS (Course Management System) – an in-house developed web portal for courses, which we describe in the next Section. In Section 3 we cover the general Moodle issues, starting with a brief overview of some technical aspects, followed by an outline of Moodle components implemented at FMG, as well as a subsection on user authentication. Section 4 illustrates our approach to blended learning in undergraduate studies on the example of the most

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elaborately implemented undergraduate course, Informatics I. In section 5 we describe the somewhat different approach to blended learning at postgraduate studies, on the example of a course named InfoTeh, as well as terminological resources developed for this level of studies. In the concluding remarks we present our plans for future upgrading of the existing system as well as for popularization of the use of blended learning technologies for the largest possible number of courses.

2. THE FMG LEARNING PORTAL

The FMG CMS portal, which was the FMG initial blended learning platform, is in essence a course management system implemented within the FMG website (<http://www.rgf.bg.ac.rs>). The system is publicly available and offers support for all active courses covering seven educational profiles, three at the Mining department and four at the Geology department, with a total of 363 courses at undergraduate studies, 254 at master studies and 135 at doctoral studies. The courses supported by the portal involve a teaching staff of 143 professors and teaching assistants. The development environment for the production of the portal was based on the PHP scripting language, and the portal database was implemented on MS SQL Server 2008.

For each of the several hundred courses available at FMG CMS two types of data were stored: *static data* – such as educational profiles for which the course is available, the number of course credits, maximum number of points for each pre-exam and exam activity, information on course content, goals, outcome, as well as the basic course materials, and *dynamic data* – information on all important events during the course: results of test and activities, various announcements, additional course materials added by teachers, etc.

In the initial phase of portal development the basic data for all courses were imported from the accreditation materials prepared for the accreditation process FMG underwent shortly before that. An example of these basic data is given in Figure 1 which depicts a portal page with basic information for the course Informatics I. It shows the educational profiles for which this course is offered, the teachers responsible for the course, the information whether the course is compulsory or elective, ECTS credits, prerequisites for course enrolment, and the goal and outcome of the course. There is also a course content outline given by a description of theoretical and practical instruction, a list of course materials, the number of course hours for theoretical and practical instruction, and the method of instruction. The grading mechanism, both for pre-exam and exam activities, is also explained in detail. Thus, the students are informed well in advance of the progress they are expected to make during the semester in order to be able to complete all the requirements for obtaining the final grade and the course credits.

While a specific course is running, teachers who are responsible for it can upload additional course materials related to theoretical or practical instruction, thus enabling students to get prepared for a specific instruction class.

Teachers are free to organize this content either for each specific instruction class, or in some other way they find more appropriate to the course. Besides course materials, teachers have the possibility of posting various announcements related to their course, test and exam results, examples of previous tests or lists of oral exam topics, links to internal or external resources, etc.

Почетак	О факултету	Студије	настава	настава	Галерија	Учак	Контакт
О предмету		О предмету					Информатика I
Обавештења		Студијски програм: Иноваторство заштите животне средине и заштите на раду, Иноваторство нафте и гаса, Рударско инжињерство					
Предавачи		Назив предмета: Информатика I					
Важбе		Предавачи: Проф. др Иван Обрадовић, Доц. др Радка Станковић					
Резултати испита		Старо предмета: Обавезан					
Резултати колоквијума		Шифра предмета:					
Испитна питања		ЕСПБ Бодови: 6					
Download		Услови:					
Практични професор		Циљ предмета: Упознавање са основним теоријским и практичним елементима Информатике са потребе Будић инжињера технике					
Термин консултација		Исход предмета: Студенти ће оладати основна рачунарска технологија и могућности њене примене у решавању иноваторских проблема					
Кабинет		Садржај предмета:					
E-mail		Теоријска наставна: Проф. др Иван Обрадовић					
		Практична наставна: Писмени испитови (доменици због курса обавезе); основне појмове, појмове информације и података и основне типове података. Из области интернета изучава се наставак интернета, адровање на интернету, прикључивање на интернет, сервис интернет, портали ресурс мреже, сигурност на интернету и јавни HTML. Потом се изучавају системи за управљање базом података: процес управљања базом података: URL, јавне сајтове информације, модели података и посебно релациони модели и јавни SQL. На крају курса се обрађује специјалистички садржај који се користи у (решавању) иноваторских проблема, што обухвата презентације и упознавање више алата: Matlab, AutoCAD, ArcGIS, потом алата за иноваторски планови, оптимизацију, кодова, заштите животне средине, транспорт, мартину индустрију.					
		Датумски наставе: Курс завршава студенти се обучавају за коришћење студенских сервиса, рад са програмима MS Word, MS Excel и MS Access, као и за коришћење језика HTML, SQL, и HTML.					
		Литература:					
		1. Ненад Милић, Основни рачунарски системи, ЦЕТ, 2003.					
		2. Годиња Павлавић-Павелић, Основне релациони базе података, Математички факултет, 1996.					
		3. Дино Вилић, Информатика I и информатика II, Школари, Школари факултет, 2000.					

Figure 1: FMG CMS web page

The FMG CMS database contains meta data, grouped by courses according to types of information, such as the date the information became available at the portal, the date it expires, that is, when it is to be removed from the portal, the information about the person who posted the information, etc.

Students can access the portal either from the computer laboratories at FMG or from any other location where Internet is available. This gives them the opportunity to get prepared for a forthcoming instruction class, download course materials or get informed about their test and exam results, date and time of forthcoming tests and exams, etc., without being physically present in the FMG building.

Course materials available on the portal to date cover approximately 25% of active courses at undergraduate studies, whereas this percentage is considerably lower in the case of master and doctoral studies. The courses covered are mostly from the two initial years of studies where the number of students enrolled is considerably bigger than in the third and fourth year.

3. THE LEAP FORWARD: MOODLE AT FMG

The introduction of Moodle at FMG represented a leap forward in the blended learning system. In 2009, a number of teachers and teaching assistants started expressing their interest in functionalities that were not supported by the existing FMG CMS, and at the same time, AMRES (*Akademaska mreža Srbije*, Serbian Academic Network) launched an e-learning project (<http://elearning.amres.ac.rs/moodle/>) aimed at fostering a new approach to instruction at the University of Belgrade through the use of diverse computer and communication technologies. The emphasis in this project was on Moodle, and within the scope of the project, teachers, teaching assistants and administrators from the entire University, including FMG, were offered courses on the

usage and user support for this platform, as well as workshops related to exchange of experience in initial application of this e-learning support system. Hence, a decision was made to introduce Moodle to the already existent blended learning system at FMG.

Moodle is a free and open source (published under the GNU Public License) LMS (Learning Management System) platform. From a technical point of view, it is a web application for creating Internet-based courses and web sites developed using the PHP scripting language (Hypertext Preprocessor), with a SQL type data base (for example MySQL, PostgreSQL, Microsoft SQL Server or Oracle). It can be run on Windows and Mac operating systems and many flavors of Linux. A particularly favorable feature of Moodle is a rather large, very active and constantly growing community of developers, who are not involved only in the improvement of the basic platform but also in the development and improvement of modules offering additional functionalities.

There are no specific technical preconditions for installing Moodle. At FMG, Moodle runs on a server with an Intel® Core™2 Quad Processor @2.33Ghz, 4GB working memory and a 500GB hard disk in RAID 1 regime, whereas the operating system platform is Fedora Core 13 (kernel version 2.6.33.3). The bottleneck in the application of this system is the amount of RAM memory. Although, as a general rule, for each 50 new concurrent users and additional 1GB of RAM is needed, the 4GB of available memory turned out to be insufficient in some situations, especially during course tests, when approximately 50 students concurrently accessed the system. It has been estimated that this amount of memory would be sufficient for only half of this number.

The currently installed version of Moodle is 1.9.9 (Build 20100609). A slightly modified version of the default installation is being used, the modifications mainly pertaining to the appearance of the environment. Third-party modules have not been used, although several modules related to additional activities have been tested, but their functionality in terms of performance was not satisfactory. After the test period, a total of 15 courses were created on Moodle during the academic year 2010/11, with about 450 students enrolled.

As in other similar products, different user roles are available in Moodle, with each role having its specific permissions. Besides the administrator, the two most important are the teacher, who can edit and modify the course content and monitor student activities, and the student, who can access the course content, perform different activities proposed, and view his/her own results.

Moodle is a flexible and modular tool, allowing various types of resources to be uploaded and activities to be defined. In the case of blended learning instruction, the resources usually include classroom material, such as lecture notes or exercises, but also all sorts of relevant additional material, such as external links, audio and video files, animations, etc. Activities include assignments, quizzes, glossaries, forums, wiki pages and

the like. The course material is organized in blocks by the course creator, in one of the several available formats, such as the weekly format or the topics format. Moodle also has a developed set of grading tools enabling teachers to assign scores to activities based on different criteria, and monitor student activity and performance.

As an e-learning support tool Moodle offers various forms of interaction and information sharing between teachers and students and among students themselves. Besides chats and forums as the most widespread forms of interaction on the web, Moodle also offers the possibility of sending personal messages to users, akin to an internal e-mailing system.

Finally, Moodle offers several types of reports that can be divided into two groups: global reports and reports at the course level. Global reports can be used for a systematic insight in both system parameters of the Moodle platform and data related to user activity. The reports generated at the course level contain data on student activity within the course, and are predominantly meant for teachers and teaching assistants who are course administrators. Thus, for example, Figure 2 shows the number of accesses to FMG Moodle platform per month, from October 1, 2010 to August 1, 2011, by the following user categories: administrators, lecturers and students.

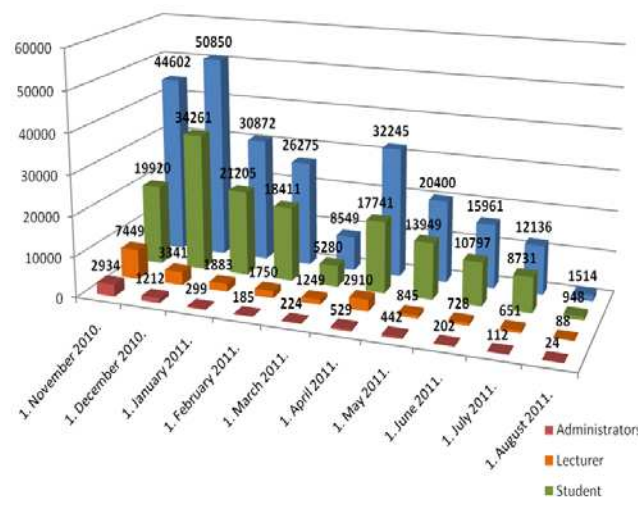


Figure 2: Statistics of access to Moodle server

There is also a "Course Overview" report that can be very helpful in comparing access to various courses, as it gives a concurrent view of activities for several courses. Figure 3 depicts the 10 most visited courses on the FMG Moodle platform from October 1, 2010 to August 1, 2011.

The process of creating and populating a course is in general complex and time consuming, which makes course backup extremely important. A "Backup Report" gives an overview showing when each course had been archived, and the archive status. For each course the administrators can define the number of most recent copies to be kept by Moodle, and set copies of the backup report to be sent by e-mail. More details on Moodle and its application in practice can be found in [4].

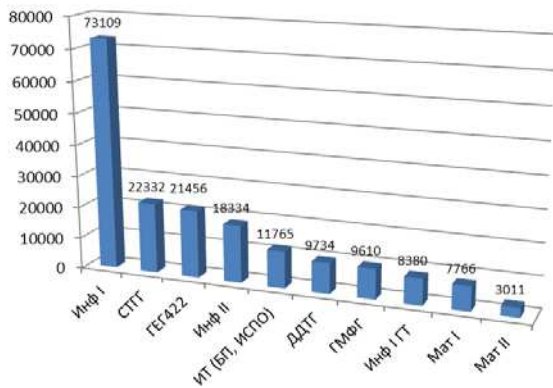


Figure 3. Number of visits for 10 most visited courses

User identity verification

The Moodle platform can be set to allow access both to authenticated users and guests. At FMG Moodle is being used in regular study courses, and student activity progress is continuously monitored during the school year, hence an authentication system permitting access to registered users only is implemented.

The Moodle platform offers support for several different authentication systems, such as:

- Manual definition of accounts,
- CAS (Central Authentication Store) server authentication,
- External user databases,
- FirstClass server authentication,
- IMAP (Internet Message Access Protocol) server,
- LDAP (Lightweight Directory Access Protocol) server,
- PAM (Pluggable Authentication Module),
- RADIUS (Remote Authentication Dial-In User Service)...

The FMG computer network features a centralized authentication system, based on the Microsoft Active Directory. The Active Directory is based on the LDAP protocol, which enables user authentication by means of a query sent do the Active Directory through the LDAP Authentication Module. For each student enrolled at FMG a user account is created in the Active Directory. The student can use this account to access a wide range of services within the FMG intranet, including Moodle. By means of the LDAP authentication module the Moodle platform is hence integrated into the centralized authentication system, which simplifies Moodle user account administration, although course administrators are additionally allowed to create manually user accounts within Moodle itself.

4. UNDERGRADUATE INSTRUCTION

We will illustrate the organization of educational content within undergraduate studies on the example of the first course implemented on Moodle, namely Informatics I. Classroom lectures for this course are held for two hours each week of the winter semester. Another three hours are dedicated to practical instruction which is performed in computer laboratories, for groups of 20 students, each student working on an individual computer under the supervision of a teacher or teaching assistant.

Organization of educational content

The course material is grouped by instructional weeks (Figure 4), and is made available to students several days before each instruction class, so that the students can get prepared for it. For each of the 15 instructional weeks, a lesson with the content presented in the classroom lecture is available, often with additional multimedia content. The lesson content is basically what students need to prepare for the oral exam.

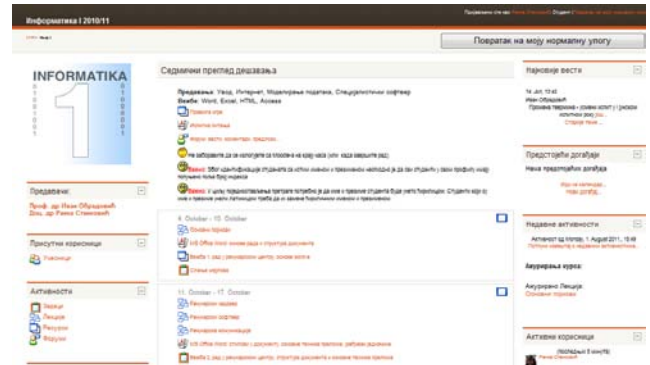


Figure 4: FMG Moodle Course web page

Figure 5 shows a part of one such lesson, which has the goal not only to present the content of the classroom lecture, but also to verify if the student has understood the concepts that have been tackled. The short pair-matching test shown at the end of the lesson serves this purpose.

Компоненте фон Нојманове машине

Контролна јединица управља радом целог рачунарског система

Аритметичко-логичка јединица извршава аритметичке и логичке операције

Акумулатор представља физичко место у коме се обављају операције над подацима: према ритму који дефинише часовник (део контролне јединице) информације се прихватају са улаза, обрађују и упућују или у меморију или на излаз. У меморији су ускладиштени подаци и програми у бинарном облику

Контролна јединица: Избор...

Аритметичко-логичка јединица: Избор...

Акумулатор: Избор...

Меморија: Избор...

Figure 5: FMG Moodle lesson web page

Practical instruction and activity monitoring

Course materials for practical instruction are prepared in the form of linked pdf documents for each particular instruction class, featuring the exercise students are supposed to complete in class. At the end of each class students upload their results on the server, and they are subsequently assessed and graded by the teacher. The grade can be accompanied by a comment, which draws the student's attention to errors in his/her work, or gives some kind of suggestion or advice, etc. Figure 6 depicts part of a grading page, where each grade is followed by an appropriate comment.

By grading student activities for every instruction class, teachers motivate students to “build” their final course grade during the semester, rather than postpone the mastering of course materials for the end of semester, which often happens in traditional instruction and grading.

Име / Презиме	Оцена	Коментар	Последња измена (Студент)
Аса Јовић	Нема оцене		
Aleksandar Milekic	10/10	Heading - font je trebao tanana, nisu	Vezba3_AleksandarMilekic_R42-10, Thursday, 21. October 2010., 16:31
Aleksandar Svabic	10/10	Nisu postavljani svišnji aktivni	Vezba3_Aleksandar_Svabic_48-10, Thursday, 21. October 2010., 16:25
Aleksandar Sitarica	6/10	Podnošje/zaglavlje nisu sređeni.	vezba3_75-10 rar, Friday, 22. October 2010., 20:42
Aleksandar Doderović	9/10	op style="margin-right: 0px;"	Vijezba_3_Aleksandar_Doderovic, Friday, 22. October 2010., 12:04

Figure 6: FMG Moodle grades web page

Besides these weekly exercises, students are additionally tested twice during the semester, when they receive specific tasks to solve individually at the computer. The relevant materials and the tasks themselves are also delivered to students via Moodle. Finally, at the end of the semester, students are given individual projects to prepare, which best show how well a student has mastered the practical part of the course.

Various reports at course level enable teachers to gain insight into student activity, such as the number of times a student accessed specific content, individual grades of students and grades at the course level. Picture 7 shows the weekly statistics of access for the course Informatics I grouped by different course content: Lessons, Resources and Assignments.

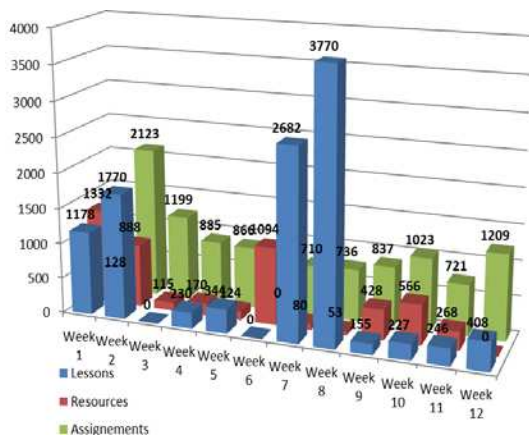


Figure 7: Weekly access to various course content

Another useful type of report, “Gradebook”, offers an overview of student results for different assignments. Teachers can use this report to analyze student grades for different assignments at the course level.

5. POSTGRADUATE STUDIES

Organization of educational content

The specific nature of postgraduate (master and doctoral) courses asked for a different organization of courses. Rather small numbers of students enrolled in different courses with similar topics resulted in a combination of course materials within a “meta-course” in Moodle. This

is how the Moodle InfoTeh course was created encompassing course material for several postgraduate courses: Databases, Intelligent decision support systems, Information system design, and GIS (Geographic Information System) technologies. InfoTech course material is hence not organized on a weekly basis but rather by different topics. Namely, GIS technologies are, for example, one of the topics of the Information system design course, whereas spatial databases are a topic within the Databases course, and the courses share the same development environment, ArcGIS, <http://www.esri.com>.

The course material for InfoTech was produced from available in-house lecture notes and textbooks, whereas for the most recent advancements and tools students are directed towards relevant scientific journals and conference proceedings. A source of additional resources are web pages of producers of different software platforms used within the course, links to relevant teams, international organizations etc. Thus, for example, Esri Developer Network (<http://edn.esri.com/>) is an indispensable web location for this course.

The course is designed to involve the students in the process of building systems for solving different kinds of problems. In the exercise part of the IS course each student receives his/her own task and dataset. The students analyze the data set individually or in smaller groups, depending of the magnitude of the problem. Some of the exercises contain database and GIS modeling tasks aimed at solving problems related to different topics. For example, this year a student group created a GIS of the FMG building. Students were given scanned raster drawings of parts of the building, which they were asked to georeference and locate within the given contour of the building in the state coordinate system, and then digitalize all rooms within the building. At the end of the course, individual geodatabases were integrated into the personal geodatabase in SQL Server. This database has already been used for different purposes, and is continually updated with different thematic layers.

Adding terminological resources

In the instruction of modern technologies, GIS no doubt being among them, one is very often encountered with the problem of terminology, namely of adequate translations of terms into Serbian. In order to help students in reading scientific articles and texts in English, and finding appropriate translations in Serbian for specific terms, we have developed an electronic dictionary of basic GIS terms. Besides the English and the Serbian term, each dictionary entry contains a short definition of the term in both languages, but without any relations between equivalents. An example of a dictionary entry, in English, and then in Serbian, is:

geodatabase (GDB), A collection of geographic datasets of various types held in a common file system folder, a Microsoft Access database file, or in a multiuser relational database ...

геобазa података (ГДБ), Колекција географских скупова података различитих типова који се смеиштају у заједничком каталогу датотека, Microsoft Access бази, или у вишекорисничкој релационој бази података ...

There is also a rather developed dictionary of statistical terms, organized in a somewhat different manner, containing both the Serbian and the English equivalent within the same entry, which proved to be more practical, although the normalization rules definitely demand that they be separated. An example of one such entry is:

population, *A population is the set of all individuals of interest in a particular study*

популација, *Популација је скуп свих индивида од интереса у неком истраживању.*

These dictionaries are not proper lexical resources, since the current format implemented in Moodle is not very flexible. However, we plan to work on this issue and enable the use of lexical resources and ontologies in Moodle, as multilingual language resources and ontologies are gradually becoming more and more important in many areas including education. Ontologies and intelligent services enable transformation of the today's Web of information and data into the Web of knowledge – the Semantic Web [5]. As the main Semantic Web tool, ontologies can be integrated into repositories of learning objects to organize the different concepts covered by the resources stored in a so called “knowledge domain ontology” [6].

An nice example of the use of Semantic Web services in education is the AquaRing project [7], which used ontology to support educational contents annotation and retrieval, to improve access to a vast amount of digital content, as well as to support enhanced education and informal learning in a specific domain. In order to achieve these goals a Semantic Web based infrastructure has been designed, implemented and tested and an educational ontology has been developed.

Another example of integration of semantic resources in education is the M-OBLIGE model for building multitutor ontology-based learning environments [8]. The model is based on local ontologies, describing the domain of each individual tutor in the environment, and external ontologies, describing more general concepts. The ontologies are used by ontology processors to decide which tutors might benefit a student who needs to learn new concepts. The model allows domain expertise to be shared, and can be used as a framework for integrating multiple tutors on the web.

Given that a Serbian thesaurus of geological terms is already developed (<http://geoliss.ekoplan.gov.rs/term>) and that it contains more than 3000 dictionary entries and the same number of English equivalents, and that the development of an ontology related to mining is underway, we now plan to connect both resources and introduce them in our blended learning approach by developing a Moodle module which would use these resources for annotation of educational content.

5. CONCLUSION

The first results of blended learning at FMG, especially after Moodle has been introduced, are very encouraging. The usage of Moodle platform at FMG confirmed that it

is a very useful tool enabling teachers to organize, and manage course materials within the blended approach. In addition to that, the availability of adding multimedia content in the learning process made the course content more interesting for students. Hence, the introduction of Moodle enhanced the interest of the students in a number of subjects, Informatics I in specific, at the same time improving their scores and performance. Finally, a higher degree of interaction between teachers and students has also been achieved.

One line of further development of this educational concept will certainly be the popularization of the available services in the eve of the new academic year, with the goal of involving the greatest possible number of teachers and teaching assistants. To that end, a workshop is planned, aimed at presenting the experience of FMG teachers who have already realized courses using Moodle, as well as available Moodle functionalities, and functionalities yet to be implemented. From a technical point of view, an upgrade of the hardware platform for Moodle is planned, as well as an upgrade of Moodle to version 2.1. In the course of setting the basis for e-learning in its full sense, technical details related to the opening of multimedia classrooms with a video conferencing system will be elaborated. One of the goals to be realized is also a fully adapted access to Moodle for mobile clients.

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