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Development of the Intelligent System for the use of University Information System

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Abstract

As one of the essential steps towards the inevitable integration process University of Mostar decided to introduce a unified information system for all members of the University of Mostar. Difficulties and some kind of resistance from the side of some employees appear in the application of this information system. To facilitate learning process, and at the same time to reduce administrative costs and save time on the training, the idea of developing an intelligent system for training the work of teachers on University Information System came up. Intelligent tutoring system provides an advanced student learning environment, tailored to its current level of knowledge. As a platform on which our system will be based, we chose an application for the creation and maintenance of online courses via the Internet, Moodle. Moodle provides teachers with full IT support in the organization and implementation of online courses. A plan is to develop a teaching system for the use of University information system, which will be fully automated and adaptable to the needs and current knowledge of each teacher who is trained on it and that gives this system the principal characteristics of intelligent system.

1. Introduction

University of Mostar is not integrated university; each faculty is a legal entity. According to the new Law on Higher Education, University of Mostar 2012th adopted a new Statute of the University of Mostar, which defines the organizational changes in the direction of the future integration process. As one of the essential steps towards the inevitable integration process University decided to introduce a unified information system for all members of the

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University of Mostar. Difficulties and some kind of resistance from the side of individual employees (especially the elderly) appear in the application of information system. To facilitate their learning process, and at the same time to reduce administrative costs and save time on the training, the idea of developing an intelligent system for training the work of teachers on University Information System came up.

2. University of Mostar

2.1. Facts

University of Mostar is one of the leading higher education institutions in Bosnia and Herzegovina. It is the only university in Bosnia and Herzegovina where the Croatian language is official language. Besides that University is a full member of the most important European and regional associations of universities and academic networks with highly developed international cooperation. It is located in the capital of Herzegovina - Mostar. University of Mostar was founded in 1977, although the history of higher education and educational institutions dates back to 1895th when the Franciscan theological study is established, the first university-level school. [3]

Within this higher education institution 10 faculties, one academy and 9 institutes, university library and student center exist. Classes are held at the undergraduate, graduate, postgraduate and professional programs through 50 different studies, 46 directions and 70 study groups.

Table 1. List of Faculties.

No.	Name of the faculty
1.	Faculty of Agriculture and Food Technology
2.	Faculty of Economics
3.	Faculty of Science and Education
4.	Faculty of Mechanical Engineering and Computing
5.	Faculty of Health Studies
6.	Faculty of Pharmacy
7.	Faculty of Philosophy
8.	Faculty of Civil Engineering
9.	Medical faculty
10.	Law faculty
11.	Academy of Fine Arts

More than 16.000 students of all groups (full-time students who study with the support of the ministry, students who pay for their studies, part-time students, students in professional studies and postgraduate students) is enrolled at the University. The performance of the teaching process involves more than 1.000 teachers and associates and over 160 employees who perform administrative and technical tasks.

University buildings which are located in Mostar are situated in two separate campuses, while the Medical faculty and Faculty of Health Studies are placed within the University Clinical Hospital in Mostar. Dislocated classes are organized in Vitez, Kiseljak, Orasje, Livno and Zepce.

From the academic 2005/2006 the University is integrated into the European system of higher education in accordance with the principles and requirements of the Bologna Declaration. ECTS credits (European credit transfer system) were introduced and studying is carried out through three cycles:

- First cycle – lasts 3 years (180 ECTS) or 4 years (240 ECTS), and acquired a Bachelor degree;
- Second cycle – lasts 1 year (60 ECTS) or 2 years (120 ESTS), and acquired a Master degree;
- Third cycle – lasts 3 years and carries 180 ECTS. Upon completion acquired Doctor of Science degree.

2.2. Jurisdiction, organizational structure and future steps

Institutional image of the education sector in Bosnia and Herzegovina is a reflection of the state, as is defined by the Constitution of BiH, entity and cantons constitutions, and the Statute of the Brcko District. On this basis the law defines competence in the field of education. Full and undivided responsibilities in education have the Serbian Republic, 10 cantons in the Federation of BiH and the Brcko District.

Because the University of Mostar is located in the Herzegovina-Neretva Canton, this Canton has full jurisdiction in education at the University of Mostar and for the University of Mostar "Law on Higher Education in the Herzegovina-Neretva Canton" is valid. Prior to adoption of the Law on Higher Education in the Herzegovina-Neretva Canton for the University of Mostar "Law of the University" was valid.

University of Mostar is not integrated university, each faculty is a legal entity with rights, obligations and responsibilities that have in accordance with the Constitution, the Law and the Statute of the University of Mostar.

According to the new Law on Higher Education, University of Mostar 2012th adopted a new Statute of the University of Mostar, which defines the organizational changes: "The University, in order to perform better quality and organization of studies, as well as more rational allocation of personnel, is obliged to carry out the integration process. The University is obliged to establish the procedure and method of integrating not later than one year from the date of entry into force of the Law, and to carry out the integration process within two (2) years from the date of entry into force of the Law." [2]

New Law on Higher Education also stipulates a transitional period for the accreditation of the University of Mostar: "(1) Higher education institutions in the Canton by coming into force of this Law, receive provisional accreditation (the license). Provisional accreditation specify the final date in which accreditation of each study program at this higher education institutions need to carry out, and all in accordance with the criteria, procedures and standards for accreditation. (2) The accreditation of higher education institutions in the Canton will be done for a period of up to two (2) years from the date of enactment of this Law." [1]

Considering all the above, the University of Mostar, as one of the essential steps towards the inevitable integration process, decided to introduce a unified information system for all members of the University of Mostar. At the same time the unified information system is one of the criteria for accreditation of higher education institutions: "g) information systems: 1) higher education institution collects, analyzes and uses information relevant to the improvement of its teaching, scientific research, and administrative activities, 2) higher education institution has information systems that enable accurate analysis of students per examination periods for each subject, a year and a study program, the ratio of teachers and students, etc. "[4]. One option was to buy an existing information system. However, suspecting that any information system meet all the needs of the University of Mostar, University started with the development of its own information system called ISS - "Informacijski Sustav Sveucilista" (University Information System) in 2010th.

3. Information system of University of Mostar

With the development of ISS University of Mostar started in 2010 by financing through various projects. At first, from the development of the ISS first module and the testing phase, in this process were involved three faculties from the University of Mostar: Faculty of Mechanical Engineering and Computing, Faculty of Science and Education and the Faculty of Economics. Later, other faculties were gradually included, and in the academic 2012-2013 began implementation of an integrated information system at all members of the University of Mostar.

The ISS has developed several modules for the work of various services, including a record of master data, work with finance, records of academic and administrative staff, student records, records of curricula, enrollment procedure, implementation of exams and classification exams, the reporting and statistics module, system administration etc. In addition to these modules the web applications with user-friendly interface have been developed, to facilitate access to and operation of the system for students, teachers and administrative staff:

- Application for Students,
- Application for Teachers

- Application for Student Service
- Application for Administrative Staff
- Application for Finance
- Application for Statistics
- Application for KPI (key performance indicators)
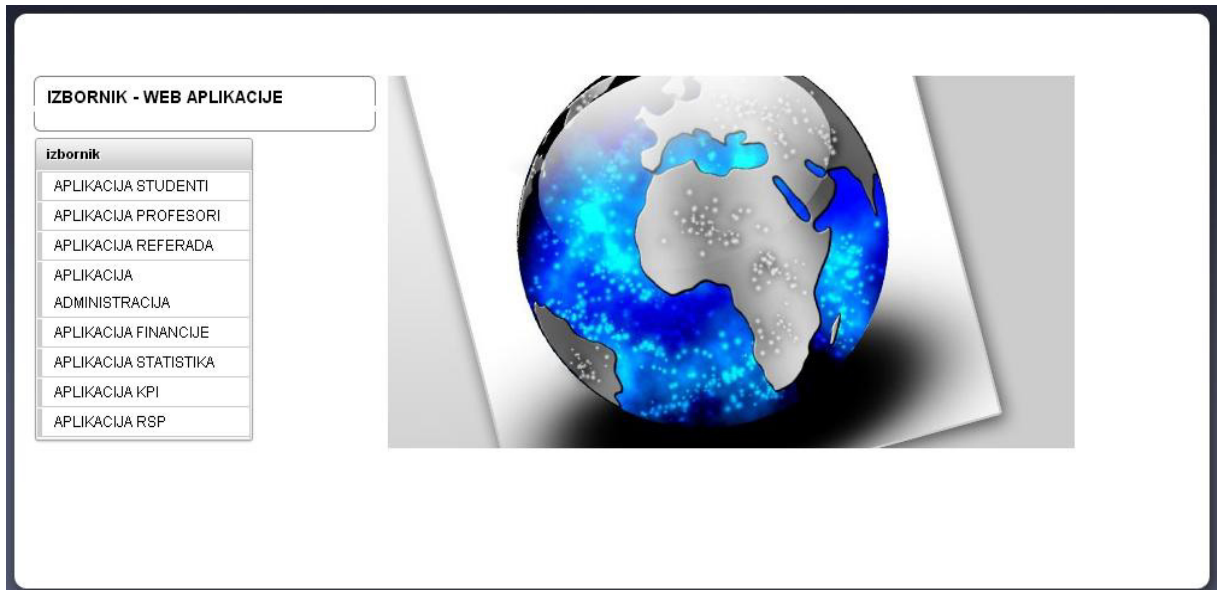- Application for RSP (register of the study programs)

Fig. 1. ISS – web application menu [11].

In order to facilitate the work of users on the ISS, the University of Mostar together with faculty members has created a network of administering the system and organized the trainings for students, teachers and administrative staff. The expert team for the implementation of the ISS was appointed at the University level, and every member of the University of Mostar has appointed an administrator to work on the ISS. Expert team organizes meetings with Faculty member administrators, coordinates their work, eliminates the uncertainties and problems, and administers ISS at the university level. Administrators at the level of Faculty organize the trainings for students, academic and administrative staff and administer the ISS at the faculty level.

Considering that for academic and administrative staff working through the information system is a new way of performing their work, and despite the user-friendly interface, trainings and written instructions, difficulties and some kind of resistance for individual employees (especially the elderly) appear in the application of ISS. To facilitate their learning process, and at the same time to reduce administrative costs and save time on the training, we came up with the idea to develop an intelligent system for training the work of teachers on ISS.

4. Development of the intelligent system for the use of University Information System

4.1. Facts

In the traditional model of teaching in the classroom, on one teacher or instructor comes 20 to 30 participants. Observing the interaction of teachers with participants show that teachers often directs their teaching and explaining toward individuals unconsciously ignoring others. Such differences in interaction provide some students better opportunities and incentives for learning, while it is not possible for others.

An alternative model of the teaching process is tutoring approach. This kind of teaching process puts teacher in the role of a personal mentor, tutor, for a small group, or even one of the participants. In a situation where one teacher teaches only one student, the student must be active, he cannot "hide", and he can get further clarification if he wants, and does not have long to dwell on what is well accepted. This method of education has proved to be very effective, but completely unusable because of its high cost and shortage of teaching staff.

This claim is confirmed by the study of the different ways of teaching, which is conducted by the American psychologist Benjamin S. Bloom, whose results were published in 1984 [5]. Results showed that there are significant differences in the achievement of students taught in different ways. It has been shown that the average student in tutoring approach group, where new teaching contents were taught with the help of a personal teacher, tutor, with periodic tests, backward-corrective procedures and parallel tests, better than 98% of the students in the group of traditional learning, where the teaching content for a given domain knowledge was taught in a group of 30 students under the guidance of a teacher with periodical tests for knowledge checking.

Presenting results using the standard deviation (sigma), the study found that the average student in tutoring approach group is about two standard deviations (2 sigma) better than the average student in the traditional group. Bloom believed that the important task of research on teaching and learning to find a method of teaching and learning in the group that would be as effective as one-on-one tutoring teaching environment, which is too expensive to be applied to a larger number of students. This problem is called the 2 sigma problem.

Today, information and communication technology is deeply rooted in a wide range of human activities. Their influence is particularly pronounced in the process of acquiring knowledge, skills and abilities in both traditional classroom instruction as well as training courses adapted to the participants.

Application of modern technology, its lower cost and wide availability, makes it possible to modernize teaching and learning process and enhance the new features that will improve its performance and adapt it to the needs of each user, without a drastic increase in the cost of organizing and implementing the teaching process. When the functionality of the application of information and communication technology is oriented toward education, and in particular the process of teaching and learning, together they form a special educational paradigm, the paradigm of e-learning.

A special class of e-learning, providing an advanced student learning environment, tailored to its current level of knowledge is an intelligent tutoring systems. Their goal is to provide students with instant and personalized instruction and feedback, without the intervention of a human teacher. These systems may be created by drawing upon existing AI theories, tools and techniques. Equally, the demands of the systems may drive researchers to make advances in fundamental AI [7]. Intelligent tutoring systems are intended to support and improve learning and teaching process, while respecting the individuality of students [8]. In this way, the system becomes a computer tutor, because teaching is carried out according to one-on-one model, which is considered the most effective way of lessons being taught. The development of this model of teaching is based on the implementation of the positive characteristics of "live" teacher, or tutor. This can be achieved with respect to a number of principles of the entire spectrum of scientific disciplines such as education, educational psychology, artificial intelligence, computer science, pedagogy and teaching and learning methods.

This model of e-learning is based on the cybernetic model of system shown in Figure 2.
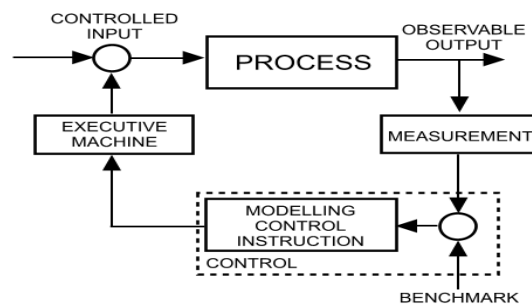

Fig. 2. Cybernetic model of system.

4.2. Knowledge evaluation

By measuring we consider a procedure that involves three elements: the subject of measurement, measurement instrument and measurement technique. The measurement must be valid, objective, reliable and sensitive. Each measurement can be carried out directly and indirectly. In direct measurement we compare the measured amount with the measure, using a measuring instrument, and its value can be read directly from the measurement results. In indirect measurement, amount is obtained indirectly from the known relations which link the measured and the required value.

Knowledge evaluation is a systematic process by which data is collected, analyzed and interpreted in order to determine the extent to which the student mastered curricular objectives. This process involves qualitative assessment techniques, quantitative method for measuring knowledge evaluation, which expresses measured levels of knowledge with appropriate grade. Knowledge evaluation, by its basic characteristics, is a measuring process, Student knowledge is a subject of measurement, the teacher is the measuring instrument and measurement technique is selected evaluation methods: asking questions, written or oral examination, testing, etc. Knowledge measuring belongs to indirect measurements because knowledge cannot be measured directly, but indirectly, through the responses of the participants. This type of measurement comes with some corresponding problems [6]:

- The possibility of error is greater for indirect than direct measurement, because some factors, other the student's correct knowledge can influence his answers (measured value factors)
- Knowledge measuring is characterized by the fact that teacher appears in the role of measurer as well as in the role of the measuring instrument. This fact increases the subjectivity and reduces the validity, or accuracy of the measurements (measuring instrument factors)
- Different testing techniques can lead to a situation that approximately equal to students' knowledge is validated differently (measurement techniques factors)

From the above the complex nature of the process of knowledge evaluation of course participants is evident. Using an intelligent computer tutor, will eliminate the subjectivity of teachers, and implementing appropriate ways of checking participants knowledge, it is possible to raise the objectivity of the process to a higher level, which will ultimately result in its better adaptability to the current level of knowledge for each participant.

An objective test of knowledge, that minimizes the influence of subjective factors in knowledge evaluation that we discussed above, comes as a solution that can eliminate the factors that threaten the metric characteristics of knowledge evaluation, such as the way in which students format their responses, subjectivity of teachers and selected testing technique, imposes. An objective examination of knowledge is carried out using a series of objective test questions or knowledge tests.

In its form series of objective test questions or knowledge tests are not different because they contain the same type of objective questions. They are characterized by the fact that the answers can be interpreted unambiguously and objectively evaluated as right or wrong. Such tasks lead students to answer, offer alternative solutions, multiple choices, seek evaluation and so on. These tasks are desirable in situations where there is enough for student to recognize the material, what will shift him to the concrete problem solving, training and application of the material. By the way in which we solve problems, objective test question can be classified into the following categories:

- Remembering and adding tasks
- Alternative tasks
- Multiple choice questions
- Tasks with two types of selection criteria
- Correcting tasks
- Sequencing tasks
- Matching tasks

 It is important for objective test questions to pre-define clear criteria what the task requires and what will be evaluated as successfully solved task, so that the outcome is less dependent on reviewer subjective criteria.

Objective test questions, by their nature, extent factual knowledge and understanding of the test material, and their use can involve a large amount of material. They encourage the learning of specific facts, and by the careful construction of test, the understanding can be also encouraged.

4.3. Development of intelligent system

The aim of educational systems is to assemble learning objects on a set of topics tailored to the goals and individual students' styles. Given the amount of available Learning Objects, the challenge of e-learning is to select the proper objects, define their relationships, and adapt their sequencing to the specific needs, objectives, and background of the student [9]. As a platform on which our system will be based, we chose an application for the creation and maintenance of online courses via the Internet, Moodle. The word Moodle is an acronym for Modular Object-Oriented Dynamic Learning Environment. Moodle is an open source project, which means that the user is granted access to the source code, the ability to change and adapt applications to their own needs. The Moodle is provided under the GNU Public License, which means that even though it's copyrighted, users are allowed to copy, use and modify Moodle, if they provide their source code to others, under the same conditions, if they don't modify or remove the original license and copyrights, and apply this same license to any derivative work [10].

Moodle learning management system provides teachers with full IT support in the organization and implementation of online courses. Some of the Moodle important features are:

- Development of a large number of courses in a single system
- Course planning - schedule of activities, calendar
- Managing users, user roles and user groups on the course
- Work with existing files and educational content
- Assessment and evaluation of user
- Monitoring user activity
- Numerous tools for communication and collaboration among users
- Systems management - backup, statistics, logs
- Comprehensive help system

Moodle gives the teacher the ability to create richly teaching content, which in addition to the information in text or graphic format can contain multimedia elements, animation and sound, as well as links to other teaching units within the course or thematically related sites on the Internet. This hypertext approach to creating educational content triggers more participants' senses, and provides an opportunity for better and more complete mastering of educational materials.

We have already mentioned that evaluation of acquired knowledge is an important part of mastering the course. Moodle system has a built-in methods and techniques to create individual tasks as well as their grouping in knowledge tests. Tests are very complex activity in Moodle, with a multitude of settings, types of questions, add-ons and options. With tests we can evaluate knowledge of participants, using several different types of questions. All kinds of questions that can be objectively assessed, is evaluated by Moodle itself, which gives the teacher more time to design questions and better preparation of educational materials.

It is important in Moodle to distinguish the concept of the test from the set of questions. Questions are created separately from the tests are not dependent on the test; they are grouped into categories and later taken from the categories of questions for a single test. This approach brings more features, such as random selection of questions for the test, using the same questions in multiple tests, etc.

All categories of above mentioned objective test questions are integrated into the Moodle system, with the possibility of their automatic evaluation, as well as providing customized feedback in accordance with the possibly wrong answers given by the participant. Using these Moodle functions, we will develop a teaching system for the use of information system at the University of Mostar, which will be fully automated and adaptable to the needs and current knowledge of each teacher who is trained on it, which gives this system the principal characteristics of intelligent computer system.

5. Conclusion

Application of modern technology, its lower cost and wide availability, makes it possible to modernize teaching and learning process and enhance the new features that will improve its performance and adapt it to the needs of each user, without a drastic increase in the cost of organizing and implementing the teaching process. When the functionality of the application of information and communication technology is oriented toward education, and in particular the process of teaching and learning, together they form a special educational paradigm, the paradigm of e-learning. A special class of e-learning, providing an advanced student learning environment, tailored to its current level of knowledge is an intelligent tutoring systems. As a platform on which our system will be based, we chose an application for the creation and maintenance of online courses via the Internet, Moodle. Moodle learning management system provides teachers with full IT support in the organization and implementation of online courses.

We have a plan to develop a teaching system for the use of information system at the University of Mostar, which will be fully automated and adaptable to the needs and current knowledge of each teacher who is trained on it, which gives this system the principal characteristics of intelligent computer system.

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