FOUNDATIONS OF WEB-BASED VIRTUAL MEDICAL UNIVERSITY. 3. DISTANCE WEB-BASED LEARNING AND PLANNING, ORGANIZING AND CONTROLLING OF REGULAR EDUCATION VIA MUS-PORTAL

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Abstract: *Laying the foundations of virtual Web-based medical university is the most important task within the project for self-evaluation and improvement of the quality education in the Medical University – Sofia (MUS). To fulfil this, a new university on-line operating PHP-based information system with dynamic database, referred to as "MUS-portal", has been developed. The paper presents the useful options of two modules of MUS portal: 1) for e-Learning in different disciplines and 2) for planning, organizing and controlling of regular education.*

Key words: *virtual university, medical education, virtual learning environment, e-Learning, information system, Biochemistry.*

INTRODUCTION

To meet better the health needs of the population, significant changes are taking place in medical education all over the world promoting the quality of higher education as essential priority. Integration of basic and clinical sciences, integration of theory and practice, implementation of problem-based learning, *e*-Learning and continuing all-life learning are important part of these changes, in unison of the recommendations of the World Health Organization [1], the World Federation for Medical Education, the European Commission (Directorate-General for Education and Culture) [2], the national strategy for higher education and the strategy of the Medical University – Sofia (MUS). Quick development of information technologies has resulted in numerous foreign and Bulgarian virtual learning environments, as reviewed by Totkov [3]. Laying the foundations of virtual Web-based Medical University is the most important task within the pilot project for self-evaluation and improvement of the quality education. To fulfil this, a new university on-line operating information system, referred to as "MUS-portal", has been developed with the main features of an advanced virtual learning environment. The aim of this paper is to present the useful options, ensured by two modules of MUS portal: 1) for e-Learning in different disciplines and 2) for planning, organizing and controlling of regular education. The system is planned to be used by all university units (faculties with their pre-clinical and clinical departments, Deans' and Rector's offices, colleges, hospitals, library, etc., but at the beginning the creation of the database, the analysis and the assessment of the advantages or disadvantages of the portal from different users' point of view in this pilot project concerns mainly the pre-clinical departments.

GENERAL CHARACTERISTICS OF MUS-PORTAL

MUS-portal operation is based on the client-server architecture model. The PHP-based application with dynamic database is developed by Netage Solutions, Inc. [4] taking into consideration the main principles of the advisable international standards, as summarized in [5] and following the conception [6], specifications and requirements of the Medical University – Sofia within the above mentioned project. The server (with Linux operation system) in one physical computer contains three logically and functionally different tiers: Web-server (Apache), Middle tier (MUS-portal) and object-oriented relational Database (MYSQL). The overall information architecture of MUS-portal is described in greater detail in [7]. The portal consists of modules for management of regular education, of distance learning, module for communications, security module and information modules about the university, its structure, resources, admission of students, scientific research and international integration, medical glossary, module for searching, etc. All the types of different users interact with MUS-portal using a common browser such

as Internet Explorer. The interface is friendly and no programming skills are required to interact with MUS-portal. MUS-portal is now in a process of exploitation by five types of users (guests, students, employees, teachers and administrators) who, as in reality, can play more than twenty different roles according to their different individual and group rights, thus providing thorough testing of the operation of the portal modules. Access rights of authorized users are strictly controlled, so that they can see only parts of the information, allowed to them. MUS-portal is many-sided and presents different sights and different pieces of information to users with different rights. Simple and advanced searching by different categories is available, again depending on the users' rights.

FLEXIBILITY OF EDUCATION

Single data entry by different users and joint creation of documents for multiple uses

Data concerning the personnel are entered by the corresponding authorized persons-in-charge of the personnel in the different university units. Thus all employees in MUS are legitimate users of the system and depending on their rights, they can participate in the education process.

Data for different curricula and schedules are entered by employees in the Rector's and Deans' offices and also by authorized persons in the departments.

All necessary personal data about regular students, their examination marks, and term and year certification status are imported into the Web-based MUS-portal automatically from the Microsoft Access Databases "Students" [8] in the local intranets of the Dean's Offices of the University Faculties, operating as virtual main books. For security considerations back transfer of data from MUS-portal into those local data-bases is not allowed at present. However, once imported in MUS-portal, the data are processed by the system to generate numerous new documents and reports.

The opportunity of direct entering of students' examination marks, term and year certifications by the assistant-professors and the professors, rejecting multiple entering of data into five paper documents (students' books, students' personal profiles, departments books, protocols, and the main faculty book) is very attractive and easy to achieve from technical point of view. However in view of the education law in force it was considered as not realistic at present. If changes occur, allowing abolishment of paper protocols, the direct entering of data will be preferred.

The module for planning, organizing and controlling the process of education processes all the data mentioned for the different specialties, disciplines, courses, groups, lectures, exercises, lecture and laboratory halls, etc. per year. The interrelations between all objects, each with its own ID number, allows the generation of various documents and reports about students' progress, work load of assistant-professors, professors and other employees, location and occupation of the halls, etc.

As an example fig. 1 shows the participation and the contribution of the different university units for developing schedules, virtual student profiles, virtual main book and other documents. A team in the Rector's office publishes the curricula and the main (initial) schedule for all the specialties and courses. The data for all disciplines in each specialty include time (day, hours), hall. Teams from the Deans offices enter the list of newly admitted students, their distribution in groups and the personal data of each student. Teams in the departments convert the initial schedules into final department schedules by specifying the numbers of teaching halls as well as the names of the lecturers for each course and the names of the assistant-professors for each group. Using data about teachers, students and department schedules, the system generates the virtual profile of each student to be used by the assistant-professors, who enter students' current marks and data about presences and absences during the term or the academic year. From psychological point of view this last activity is considered as training and getting used to

the system to facilitate in future the direct entering of all data in the departments, including examination marks. Other useful effects are the opportunities for joint, easy and quick interrelation of different university units, located in separate and remote buildings. Like in reality, the access rights of these different participants are strictly regulated. Using MUS-portal saves time and labor and ensures transparency and opportunities for quick corrections of educational process.

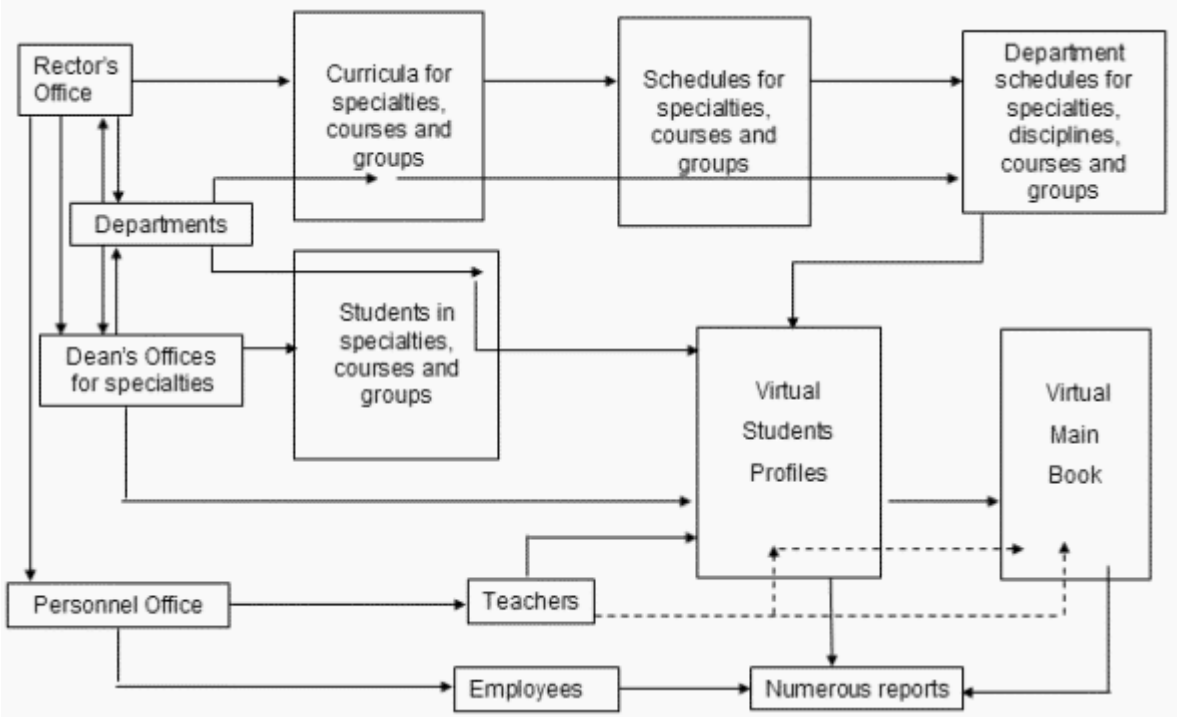

Fig. 1. Interrelation between different, separated and remote teams from the Rector's office, Deans' offices, departments and Personnel Office for entry of data and generation of different documents and reports by the system.

***E*-learning - options for the students**

At admission the personal data of all regular and correspondence students in MUS are entered by the responsible employees into the local database of the Dean's office and from there they are imported into MUS-portal. This leads to automatic creation of login and e-mail accounts in MUS-portal for each new student. The system recognizes their accounts (combination of user name and a password) and allows access to all available teaching materials for the corresponding year and to materials for the disciplines in previous years, for which the examination is yet not taken.

External students can apply for distance learning courses by registering as candidates for distance students and taking entrance examination tests. Depending on the results on these tests, the candidates can be either accepted or rejected as distance learners.

The Information architecture of the module for creating and using Web-based courses is based on the information architecture of the system for Web-based learning at discipline level [9]. The module for distance learning in MUS in each discipline consists of five important parts:

1. Lectures as source of basic knowledge;
2. Interactive tests for (self)-assessment of theoretical knowledge;
3. Situation simulations (in particular clinical case simulations), which facilitate integration of theory with clinical practice;
4. Glossary for discipline-specific terms;

5. Helpful resources, such as annotation, curricula, programs, syllabuses, schedules, etc, according to the requirements of the e-Learning Initiative [2].

The lectures contain coloured illustrations, animations, virtual molecular models and virtual models of complex processes and expensive experiments.

The tests for assessment of theoretical knowledge consist of items at I-III level according to Bloom taxonomy of learning objectives. Different regimes of item presentation are possible – consecutively or randomly in the whole test or in part of it. Various types of questions (multiple choice, multiple response, fill-in blanks, ranking, matching, questions requiring free-answer or questions-announcements) are assessed automatically by the system. In the multiple choice, multiple response and fill-in blanks items the distribution of the answers is random in order to abolish the mechanical remembering of the true answers. The system recognizes five types of answers: correct (complete and true), incomplete, wrong, inexact, omission. The use of positive and negative weights for the true and wrong answers, respectively, allows differential assessment of the knowledge.

The simulations of clinical cases are specialized tests dedicated on clinical problems thus facilitating achievement of problem-solving skills. The items in them are at III-VI level according Bloom taxonomy of learning objectives. The test as a whole checks creativity, problem-solving skills and decision-making skills. The items are presented according the logical order for solving the case. Transitions from the current item are possible to any next, previous or current item. Different outcomes are possible depending on the scenario and the student's mastery. Each decision of the student, playing the role of the doctor, is commented and assessed.

The terms and definitions of the different disciplines are intended to form a total medical dictionary.

Other useful options for the students are advanced searching and opportunities for communication with their teachers or between themselves and participation in different forums at different levels.

E-learning - options for the teachers

Teachers without any designer or programming skills use the common browser Internet Explorer to work on-line with the MUS-portal map (administrative section) and create and edit Web-based courses in their corresponding disciplines. Their work with texts is facilitated by a text-editor, in-built in MUS-portal. The editor allows all necessary options such as formatting of fonts (style, size, color, sub- and superscripts, creation of hyperlinks to external sites, etc.). Internal hyperlinks are very important for integration of different parts of the teaching material. Graphic files and other multimedia files (avi- and mov-files) are easily entered into MUS-portal into folders corresponding to the discipline sections. On choosing a figure, the teacher sees and copies the relative pathway to the picture, which is necessary for insertion of the figure in the text.

The large Biochemistry MYSQL database was created in a previous pilot research [9-12]. It consists of Lectures (20 chapters), interactive tests (more than 700 questions), clinical case simulations (11 cases with more than 200 items), glossary and other resources. This database was transferred automatically from the PHP-based Course Generator [9, 10] to MUS-portal. Examples of other departments that have begun creating their teaching materials in the database of MUS-portal and participate in the testing procedures are the pre-clinical Departments of Pharmacology and Toxicology [13, 14], of Biology, of Microbiology, etc. The clinical Departments of Otolaryngology, Neurology, etc. also prepare teaching materials for e-Learning.

The teachers can receive reports about students' progress and about the quality of the test items (Difficulty and Discrimination indexes), as well as reliability of the test as a whole. In all lists of teaching materials sorting is possible by the titles of the columns of the list. Renumbering and insertion of new elements in all the lists with teaching materials at

any desired position is easy. This allows regrouping, creating and multiple using of new derivative materials from the available lecture topics and test items. For example preparation of new annual test combinations is very easy because the teacher can select any combination of items in different tests and create a new test.

DYNAMICITY OF THE SITE, FLEXIBILITY CONCERNING THE INFORMATION AND POSSIBILITIES OF UPDATING

A very important feature of MUS-portal is the dynamic character of data in the site, which makes the work with MUS-portal easy and quick. Each University unit, no matter in the Rector's office or in the faculties, or in another structure, has the opportunity at any moment to edit, delete or add new dynamically generated pages and sub-pages in the modules they manage, excluding the main page for aesthetic and security considerations.

The status of each information can be changed from public (visible by all users, including non-registered ones) to internal or hidden information (visible only by different types of authorized users). The information can also be archived.

Authors of teaching materials, for examples lecturers, have the opportunity for each lecture topic to define the types of users that can see or use the lectures.

The MUS-portal allows publication of information at every level (university, faculty, department or distance course) in dynamically generated pages and sub-pages, for example: orders, instructions, guides, thus allowing simulated information transfer in top-down direction – from the Rector's office through the Faculties, the Pre-Clinical University center and other structures to the Departments, as well directly to each of the structures. Transfer of information is possible also in the opposite direction. Various reports from the Departments are available to the structures mentioned or directly targeted at some of them. This information includes virtual students' profiles (progress, presence control, current grades, individual or group/course examination grades, students' questions, opinions, signals from any registered user or from guests who can see a small part of the MUS-portal, etc.). This transparency of information facilitates making decisions and corrections when necessary.

In view of the restrictions of the law of confidentiality of personal data some of the fields concerning employees are blank at present until the Personnel-in charge employees are convinced in the security of the system. During designing and developing of the system measures were taken to ensure easy updating, e. g. addition of new fields for necessary meta-data of the objects in the database in case of changing laws or accepting definite educational standards ensuring inter-operability of the virtual e-Learning environments.

CONCLUSION

Developing of MUS-portal as a whole, and in particular the modules for distance learning and for planning, organizing and controlling the process of education, with their numerous useful options lay the foundation of the virtual medical university and facilitate the coordination of different teams in remote buildings and the management of the complex educational process. The modules ensure rich functionalities for flexible Web-based problem-solving oriented *e*-Learning. Via the browser-based interface in the administrative module the teachers can create, edit and regroup Web-based courses, consisting of lectures with illustrations, animations, virtual models of complex processes, virtual models of expensive experiments, interactive tests to (self)-assess the theory, interactive clinical case simulations to integrate theory with practice. The dynamic database of interrelated interactive learning materials, supplementary useful resources, various types of users, schedules, halls, etc., effectively managed by the MUS-portal modules described, together with other useful options of the portal, such as advanced searching, communications abilities, etc., allow to conclude that the MUS-portal is nearing

the characteristics of an advanced virtual learning environment according to Totkov's classification [3] with specific advantages for education in the field of Medicine.

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