A CONCEPTUAL MODEL OF WEB-BASED EDUCATION QUALITY ASSESSMENT SYSTEM IN MEDICAL HIGHER SCHOOLS

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Abstract: Quality and its assessment are essential for modern management of the educational process. It is included in the mission, goals and tasks of every higher school detailing in collection, analysis of the needed information and consequent adequate management decisions. The paper deals with the automation of this process. A conceptual model of "Web-based education quality assessment system" in medical higher schools with a focus on survey is presented.
A study of the main modern conceptual models and approaches for a design of the architecture of the software application for quality assessment in medical higher education is presented. The chosen technological decisions for design and development of the information system are justified. Functional and non-functional requirements and limitations for the system are defined.
Keywords: quality assessment, higher education, conceptual model, assessment system

INTRODUCTION

Quality and its assessment are essential for modern management of the educational process. It is included in the mission, goals and tasks of every higher school detailing in collection, analysis of the needed information and consequent adequate management decisions. Constructive student feedback, establishment of systems of continuous control, and implementation of changes based on a scientific conceptual framework will help the education to move from quality assurance to quality improvement. The quality of education is a responsibility of all participants – lecturers, students, institution management [1].

The paper deals with the automation of the feedback process, including the analysis of the requirements for the development of a model of a "Web-based education quality assessment system" (Web-EQAS) and its design. In the focus of the statement we present modern conceptual models and approaches for a design of the architecture of the software application for quality assessment in higher medical education. Functional and non-functional requirements and restrictions for the system are defined. The Automated Feedback Generator, for example, is an automated feedback software system, designed with the aim of providing superior quality assurance and efficiency in both

assessing student assignments and providing feedback [2]. The testing demonstrates that it offers quality control, efficiency and effectiveness benefits whilst generating consistent feedback from a student perspective [3].

In conclusion, a study of the major contemporary models and approaches for designing the architecture of the software application and its construction are presented. We have made a rationale for the selected technological solutions for the design of the architecture and its construction.

1. ANALYSIS OF THE REQUIREMENTS FOR DEVELOPING A MODEL OF THE "WEB-BASED EDUCATION QUALITY ASSESSMENT SYSTEM"

a. Functional requirements

In the stage of analysis of the requirements we have created a classification in which the functional requirements are placed into several groups. Quality requirements and restrictions to the system are shown. Target groups, their responsibilities and needs are classified.

A survey conducted in September 2016 showed the positive attitude of students toward registration in a "Web-based education quality assessment system". It also demonstrated a positive attitude toward filling out online feedback surveys as a part of the quality management in the Medical University of Plovdiv [4]. Therefore, we examined the sites of national and international universities which are consistent with the educational policies and strategies for the development of higher medical education. As a result, we defined the following functional requirements (FR) to a modern information system (IS).

b. Non-functional and quality requirements

Non-functional requirements called quality requirements (QR) are crucial in building a software system [5].

c. The main restrictions are related to: Data processing system; Realization of communication; Consistency with copyright law; Consistency with legal requirements for exchange of personal data; Access through the Internet [6][7].

Thus the defined requirements for a modern IS show a necessity of designing a Web-EQAS as a IS that provides quality management with the necessary level of customization. That requires a study of the following components:

- Environment;
- Users (subjects).

The environment is the main component which contains the services for assessing the quality of education, access to surveys and control of user access to different functionalities of the system. It is represented by a technological platform that provides all the necessary elements – technologies for synchronous and asynchronous communication, user management, content management, evaluation and monitoring, web services.

Users are students, postgraduate students, teachers and staff from the Medical University – Plovdiv.

The analysis of requirements and the design of Web-EQAS describe FR and QR to the system taking into account the basic subjects, objects and processes in the field of research – namely assessing the quality of education. All aspects of the technical documentation describe elements of the architecture of the software application.

2. DESIGNING A "WEB-BASED EDUCATION QUALITY ASSESSMENT SYSTEM"

As a result of the studies and systematization of sources, consistent with the functional requirements formulated to the Web-EQAS, the following service groups are differentiated:

a. Administrative assistance to the process of the survey

b. Process management of the surveys – Feedback System of the Medical University (FSMU) as part of the Web-EQAS

c. User management (roles and rights).

d. Security management and access to the system.

An essential feature of the established groups of information services is their connection with each other and also with external systems.

Figure 1 shows the integration of the Web-EQAS with external systems – the IS of the Ministry of Education and Science (MES), the IS of the National Evaluation and Accreditation Agency (NEAA), IS of the Medical University (ISMU).

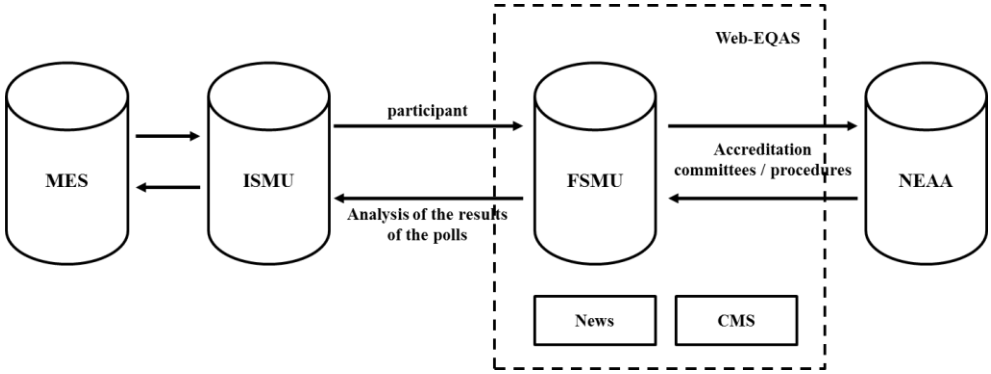

Figure 1. Integration of Web-EQAS with external systems

Those **automated actions** are of great importance in the design stage of the Web-EQAS. We can highlight the following key working processes:

- Process management of automation and creation of surveys including defining the purpose and the respondents.
- Process management of gathering the information, including protection from unauthorized access and recurrence of responses from one person.
- Process management of data processing, and disclosure and storage of the results.
- Process management of storing information about the history of voting.

Automated service of the survey process – aim: to automate the management including the management of:

- publicly available information;
- planning the educational process;
- assessing and analysis the results.

The next BMP-chart describes the different elements of the management of the FSMU which are subject to design and future implementation (Figure 2).

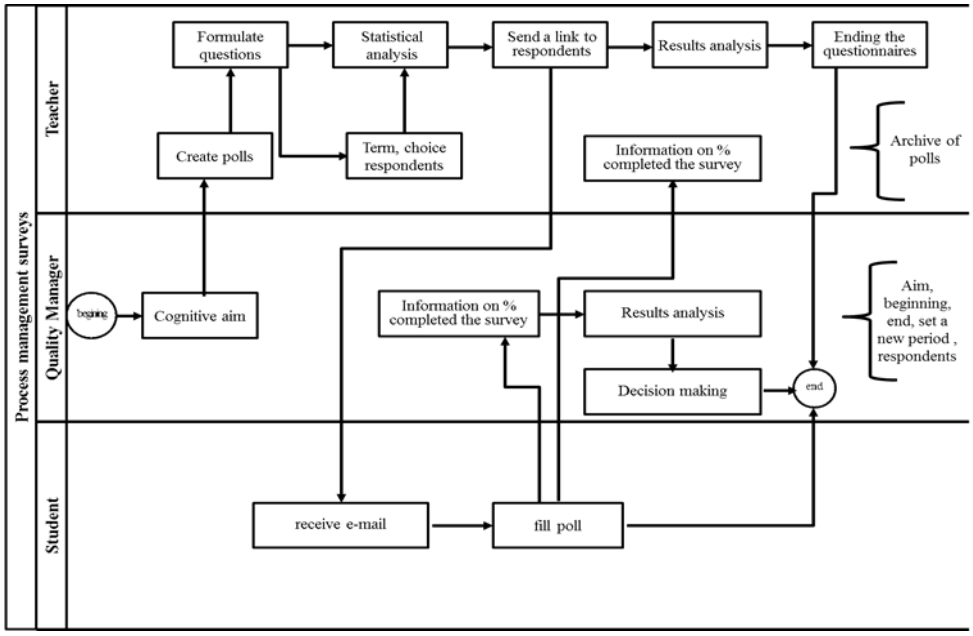

Figure 2. BMP-chart of the different elements of the management of the FSMU

Managing the conduct of surveys – teacher, quality manager and students (Figure 3, Figure 4, Figure 5)

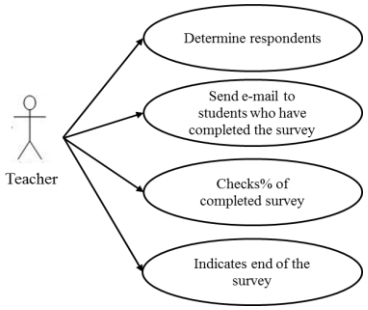

Figure 3. Use-case diagram teacher

Figure 4. Use-case diagram Use-case diagram of quality manager

The special feature in the described actions that are a subject to automation is the provided verification whether the survey is fully completed or not. If it is not the system automatically sends a new message to the non-respondents.

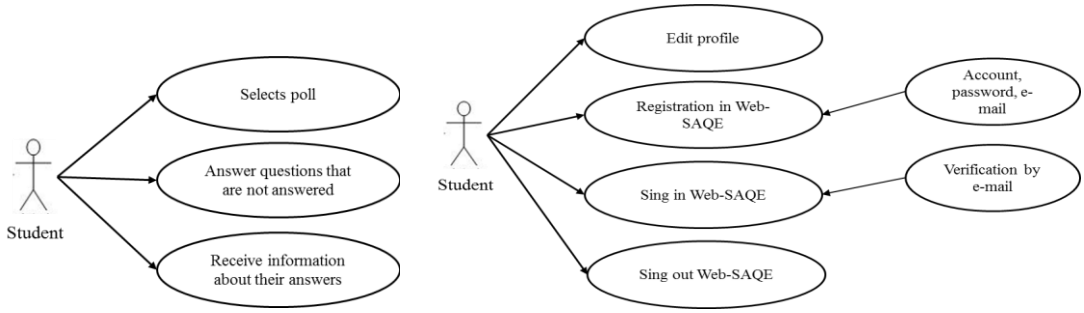

Figure 5. Use-case diagram student

Diagram 4 shows that a direct access to the aimed survey is provided in order to reduce the time required for fully completing it.

The log in to the Web-based IS for assessing the quality of education is also through e-mail, Google, Twitter, Facebook which requires an integration with them.

The log out of the Web-EQAS traces the session. Prolonged inactivity leads to automatic logging out of the system.

Automatic processing of surveys and export to other systems

To ensure automatic processing of surveys absolute and relative frequencies of responses to the questions are calculated. The system displays results as a reference predefined by set criteria into faculties, specialties, professional fields, etc.

For the convenience of the customers references can be exported in Excel.

With this in mind the next diagram describes the tasks which have to be done in the stages of processing the input information.

User Management

Module for monitoring user activity. Roles – students, teachers, manager-administrator, quality manager.

Realization of a role model in the system:

- identification;
- authorization.

The roles (groups) of users which are supported in the system are: student, teacher and administrator (of the system). Figure 6 shows the authorization process.

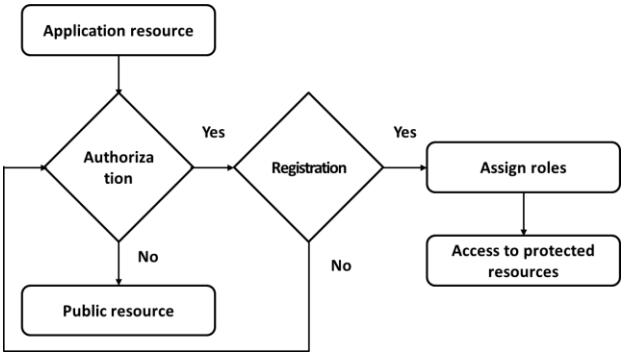

Figure 6. Authorization process

When the registration is successfully completed the Web-EQAS sends an e-mail for this. The user is able to restore their forgotten password. It is taken into account that a teacher can be also an administrator or a manager. In this case it combines all the roles.

Security and access management

Providing personalized access to a designed software system puts the issue of the services for data protection and limited access to information on the table. This group of services must meet the following requirements:

- **Creating access restrictions on a functional level**
- **Creating restrictions on DB level**

These requirements provide two levels of information security: functional security and data security.

Functional security involves determining users' access to system functions. Data security includes providing users' access to the specific data.

The data access in the Web-EQAS must follow a logical consequence and hierarchy of user groups. The IS provides services for user management and access control to information. The system allows access in two ways – through public (anonymous) access or through identification and authorization. In the first case the information is available to users without the need for pre-registration (e.g. a public presentation of the module). In the second case the access is allowed only for pre-registered users who are classified according to their roles.

3. APPROACHES IN THE DESIGN OF SOFTWARE ARCHITECTURE

The development of the software industry and the increased need for building quality software entail creating new paradigms, methods and tools for efficient design of software systems.

Modern paradigms for designing the architecture of the software application offered by Bontchev (2012) are [5]:

- Object-oriented design;
- Component-oriented design;
- Design based on a contract and context-oriented programming;
- Service-oriented architecture design;

Component-based architecture and service-oriented architecture (SOA) are currently at the center of object-oriented design. The component-oriented design software introduces a new paradigm in which systems do not work from scratch, but clump of existing components [8]. Components are more abstract entities compared to classes. Each component is a separate service provider. The construction of component-based software and SOA aims to reduce the cost of construction through prototyping quickly-built software systems that are flexible, lightweight and easily maintained.

- **Designing the architecture of Web-EQAS**

For designing the architecture of the Web-EQAS the component-oriented paradigm is chosen (Figure 7). This is due to the large range of complete technological solutions that exist at the moment. Linking them into an integrated system presupposes an integrated client-server architecture that performs logically completed cycles of subject area processes.

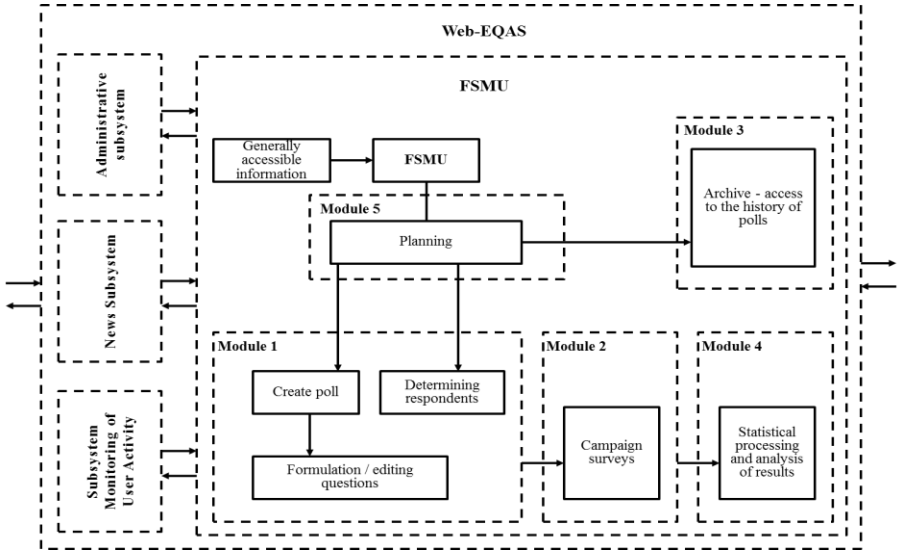

Figure 7. Component-based model of Web-EQAS

The design of the individual components is governed by two main principles in software design – poor connectivity and strong consistency. The less information is exchanged between the components (i.e. components are simpler), the weaker the connection is. The main task of the consistency is to ensure that all the elements inside the component solve a common problem [9].

4. DATABASE DESIGN APPROACH OF WEB-EQAS

At the database design stage of Web-EQAS changes have been made to the existing tables of the selected Content Management System (CMS) and new ones have been created that satisfy the implementation of the defined functional and non-functional requirements to the system. The ability to exchange data between existing framework tables and tables which are external to the selected module is discussed. For example, all data for students, lecturers, managers, administrators and all actions performed by them are stored in the database of the FSMU in accordance with the design framework. To preserve data integrity, algorithms have been developed to implement the data exchange between existing Medical University systems and the FSMU survey module as parts of Web-EQAS.

A relational model has been used to design the Web-EQAS database, distributed in more than 45 tables. A conceptual model of the main objects in the database is presented in Figure 8. It is open for future development.

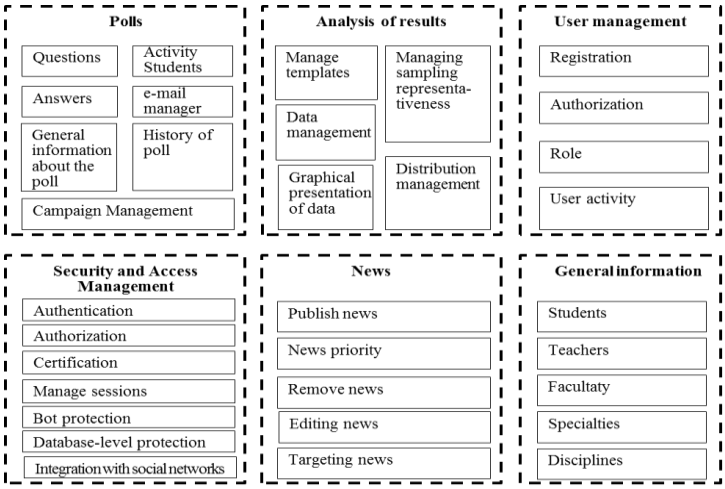

Figure 8. Conceptual model of the main objects in the Web-EQAS database

5. TECHNOLOGICAL REQUIREMENTS FOR THE WEB-EQAS

An important step towards developing a web application is the choice of programming language. In modern Internet applications different technology solutions are used. The choice to develop the individual functional requirements defined in this study is a choice between HTML, Java (JavaScript) and PHP, each of which has some advantages and disadvantages:

MySQL has been selected for the database management system. Considerations about the choice that was made can be summarized as follow:

- reduced time to create large DBs;
- high level of productivity, accessibility and security;
- easy deployment, management and optimization of data and data analysis;
- it provides a mirror image in the event of a malfunction in the primary server;
- it is free and there is available literature about it.

An important technology requirement for Web-EQAS is server selection [10]. The choice is Apache Server which is the most popular web server [11]. It can support both PHP and Perl applications.

The development of modern communication and information technologies and the distinct trend in hardware development towards the imposition of mobility-related devices and technologies call for more and more frequent use by users of services tailored to these devices and technologies. The widespread use of laptops, netbooks, smartphones and tablet devices requires Web-EQAS to support services available through mobile devices [12].

When designing Web-EQAS the need for the system to offer access to all its services through mobile devices has been also defined.

CONCLUSIONS

The presented model of the FSMU as a component of the Web-EQAS complies with specific requirements for compatibility with the university information system and it is also a part of it. The Web-EQAS is designed to operate as an integrated Web-based system. It provides a high level of security and safety of the data (in data transmission so that they cannot be intercepted and/or modified) by the creation of backups, archiving, recovery and protection). A high level of data integration is maintained by providing a repository for data and system development to update the data, suggesting the use of an integrated and dynamic DB. The Web-EQAS provides access to all pre-authorized users (students, teachers, employees) regardless of their location. The system is Web-based and meets accessibility standards. The system is compatible to work with mobile devices (smartphones, tablets, netbooks, etc.). The architecture of the system is based on a modular principle for easy integration into various functional modules. The survey module which is incorporated in the Web-EQAS provides the ability to dynamically manage surveys.

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