Quality Monitoring in Higher Education: Elements of a Software Support System

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Abstract – This paper describes the basic elements of the software support system for quality monitoring in the area of higher education. We described the current situation at University of East Sarajevo, problems and shortcomings of existing solutions and the motivation for the development of new solutions. We proposed several suggestions for improvements. Some of the segments of the system for monitoring the quality of the teaching staff are also described.

Keywords – higher education, quality, software support.

I. INTRODUCTION

Quality assurance, control and monitoring are the processes that are continuously taking place in all areas of human work in order to improve quality of products and services. Minimum quality requirements are defined by the applicable standards in the appropriate workfield. Quality standards in higher education usually define the minimum requirements that higher education institutions must meet in order to satisfy the basic criteria of the quality of their work. In addition to requirements for the quality of institutions themselves, requirements for the quality of the study programmes, that are realized at higher education institutions, are also defined. In order to monitor the quality it is necessary to identify relevant quality indicators and monitor their values over time. Based on the results obtained by monitoring the values of quality indicators it is necessary to take appropriate actions that should improve quality. The effects of the activities undertaken are assessed based on comparison of these parameters before and after their implementation, afterwards appropriate decisions on the next steps are made.

Quality of products or services in any industry is affected by many factors. The quality of a product depends on the quality of raw materials and the quality of the entire production process. A similar analogy is valid and can be applied in higher education, where the quality of graduates and their output level of qualifications and skills, is affected by factors such as level of knowledge at the time of enrollment, quality of study programmes, physical and human resources involved in the teaching process, student motivation to learn the course material, and so on. For monitoring quality in higher education there is a need to constantly collect and analyze vast amounts of data about the teaching process, and to get precise information from this data that is necessary for making the right decisions to improve quality. Data to be collected and analyzed usually include data about students, teachig staff, material resources which the institution has at its disposal, various elements of the teaching process, and data related to administrative and business activities of a higher education institution.

It is clear that the use of modern information and communication technologies (ICT) in this area is imperative. The usage of ICT enables more efficient and easier way to carry out activities of collecting, processing and analysis of relevant data needed to monitor the quality, as well as its adequate presentation. In the case of possibly large higher education institution, especially if it is heterogeneous and distributed and if there is a large number of external associates (as it is the case with the University of East Sarajevo), efficient data collection and its processing and analysis is possible only in the case of properly designed, implemented and used special-purpose software. In this paper, the situation at the University of East Sarajevo (UES) in terms of software support for quality monitoring activities is described. We presented some of the elements of a software system for monitoring quality, with special emphasis on monitoring the quality of teaching staff as one of the key factors for quality assurance which greatly affects the students (eg how the teacher motivates students to work in a given subject).

II. QUALITY MONITORING AT UNIVERSITY OF EAST SARAJEVO

UES consists of 17 organizational units that are distributed across the eastern part of Bosnia and Herzegovina (BiH). The University operates on the model of integrated university in the legal sense, but in geographical terms it is highly distributed since its 17 organizational units are located in 8 different cities. Similar to other higher education institutions in BiH, more intensive activities in the field of quality assurance at UES began only in recent years. The first self-evaluation report for UES and all of its organizational units was made in 2009. Starting with the year 2010, the report is prepared in accordance with the Criteria for accreditation of higher education institutions in Bosnia and Herzegovina [1], in the form defined by the State Agency for Higher Education Development and Quality Assurance in BiH (the Agency).

At the time of writing, there is no clearly defined set of quality indicators of higher education institutions in BiH or study programmes that are realized in them. Document containing the reference standards against which accreditation of higher education institutions will be made, was adopted during the year 2010 by the Agency, in the form of the framework of criteria for accreditation of higher education institutions without precisely defined quality indicators. Criteria for accreditation of study programmes are still in the

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process of development. Therefore, higher education institutions a left with a lot of freedom in the interpretation of criteria for accreditation and selection of quality indicators. In this sense, the UES selected the quality indicators based on the criteria for accreditation of higher education institutions. Selected indicators of teaching process quality are attached to the self-evaluation reports in the form of additional statistical reports containing information on students, student success rates at exams, teaching and administrative staff, material resources and scientific research.

Part of the required information is available in the official records of the UES, in the current information system databases, while a significant portion of the data is not collected in a uniform and systematic manner. The UES information system (IS) is a software solution based on open-source technologies. It is used individually at all organizational units of the UES. Some of the shortcomings of the current version of the IS, in the context of organizational structure of the UES, are that there are no aggregate data on the university level, nor the system can support the creation of statistical reports in the form required to monitor quality. In order to provide the necessary data in an efficient way, the development of new and improvement of the existing modules of the IS is initiated, for the purpose of the software support to quality monitoring.

III. SOFTWARE SUPPORT FOR QUALITY MONITORING

In order to solve the previously described problems, the development of software systems to support quality monitoring was initiated. One of the main functions of the system is the integration of the existing data, from the individual databases of organizational units, in a central repository of data that is used to monitor quality indicators and generate reports at the university level or the individual organizational unit level. Another important feature is the recording of data for which there is currently no electronic record.

A subsystem for integration of the existing data implements the functionality for extraction, transformation and loading a central data warehouse at the university level. Information stored in the data warehouse includes data about students, teaching staff, study programmes and course. The data on teaching staff also stores the results of student surveys for evaluation of the teaching quality. Software tools based on the application of business intelligence are used for analysis and presentation of these data. The data from the data warehouse was processed and stored in the form of OLAP cubes. Several OLAP cubes were designed and implemented for analysis of data on various aspects of the teaching process.

For analyzing data about students, we realized OLAP cubes that enable the following analysis:

- analysis of the quality of students enrolling the university, based on their succes in the high school,
- analysis of data about students at the level of university, organizational unit or lower levels,
- analysis of success of students at exams and assesments,

- analysis of the average total length of study and success of students in their studies,
- analysis of the rate of student passing from one year of the study to next higher year of the study.

Each of the mentioned OLAP cube provides an analysis of data about students by a number of criteria, such as year of entry to the study, study programme, gender, type of funding, year of the study, student success from high school, type of high school, place of birth, place of graduating from high school, etc.

An important segment of the system for monitoring the quality is a module for the analysis and monitoring of the quality of the teaching staff. One indicator of the quality of the teaching staff are teacher ratings in student surveys. Collecting student opinions about the quality of teachers is done electronically, using a special web application used for conducting the student surveys at the university level, which is used from the academic year 2009/10 [2]. Faculty of Electrical Engineering of the UES has been using this application for more than five years. The application enables tracking results and trends of teachers ratings in the student surveys. In addition to teachers, students are using this application to evaluate the quality of their study programmes, the quality and availability of other resources used to support the educational process. In the next chapter we will give more details about the system for monitoring the quality of the teaching staff.

For a more detailed analysis of data about the quality of the teaching staff, based on the results of student surveys, we designed and implemented the OLAP cube that enables the analysis of teacher ratings on an arbitrary level (university, organizational unit, study programme, year of study, course unit) and the arbitrarily chosen criteria (type of involvement of teachers , teacher gender, student gender and other criteria) [3].

Another important indicator of the quality of the teaching staff are publications, participation in projects and other results of scientific research. In addition to individual results related to the teachers, it is required to monitor the aggregate performance of university and organizational units in the field of scientific research. Unfortunately, this segment is not covered by the current functionalities of the UES IS. Module for recording the results of scientific research of teachers is one of the additional modules of IS whose development is recently started, and whose implementation is expected by the end of 2012.

Other additional modules of the quality monitoring system, whose implementation is planned by the end of 2012, are a module for recording teaching activities of students and teachers by application of RFID technology, and a module for tracking employment of the UES graduates.

Module for recording teaching activities of students and teachers should enable automated recording of the student attendance to the classes, number of classes perfomed by teaching staff, and also recording the usage of the resources for teaching process like classrooms and laboratories. Implementation of this system should contribute to the quality of teaching process through the automated records of

important data about the educational process. Based on the analysis of these data it is possible to identify certain problems and weaknesses in the teaching proces and to influence on their elimination in order to improve the overall quality of the teaching process.

The quality of the study programmes can be monitored using several indicators. Some of them have already been mentioned and are related to the indicators of success of students, quality of teachers, quality and availability of material resources for the implementation of study programmes. Some additional indicators of quality of study programmes are related to employment of graduates. Based on data about employment of graduates, such as areas of work in which graduates are employed, the average employment rate, the average waiting time to employment, one can conclude about the quality of study programmes. These data can not be acquired easily, especially if not adequately using the possibilities offered by a modern information and communication technology. It is necessary to maintain the relationship with graduate students after graduation, and to collect and analyze data relevant to the analysis of the quality of study programmes. This need is the motivation for the development of additional modules of the system for quality monitoring, which will enable the collection, recording and analyzing data on employment of the UES graduates, development of their careers and obtaining feedback from relevant areas of the profession in order to improve the quality of the study programmes.

IV. MONITORING THE QUALITY OF TEACHING STAFF

An important segment of monitoring quality in higher education is monitoring the quality of the teaching staff. Evaluation of teachers is common practice in many universities around the world. The most commonly used instrument for collecting students' attitudes about the quality of the teaching staff are student surveys carried out in written or electronic form. In recent years, many universities use web based online surveys because of the many benefits that they provide compared to paper based surveys [4,5].

All organizational units of the UES have been conducting student evaluation of the teaching quality in the last few years. At the beginning, the surveys were performed in different ways, using the paper form or electronically, without the use of unique forms and unique procedure. Starting from the 2009/10 academic year, this process is uniformed so the entire university uses the same system for electronic survey of students, and surveys are conducted in the same way in all organizational units. The content of the questionnaires and the software system for online students' surveys are constantly improved in accordance with proposals and recommendations of quality assurance bodies at the UES. Besides the assessment of the quality of elements of the teaching process, the questionnaire contains a section with general information about the participants of the survey, such as gender, type of funding and the average grade on the exams, which can be used for additional analysis of survey results according to profiles of participants. It is important to note that students' anonymity is guaranteed during the process and there is no

way to establish a connection between the ratings given by students and their identity. This is very important for students to objectively evaluate all elements of the teaching process, especially the teaching staff, without fear of beeing punished in any way if they give negative comments or ratings.

Web application for student survey was developed at UES Faculty of Electrical Engineering. It was first put into use in the summer semester of the academic year 2006/07. The architecture of the application is shown in Fig. 1.
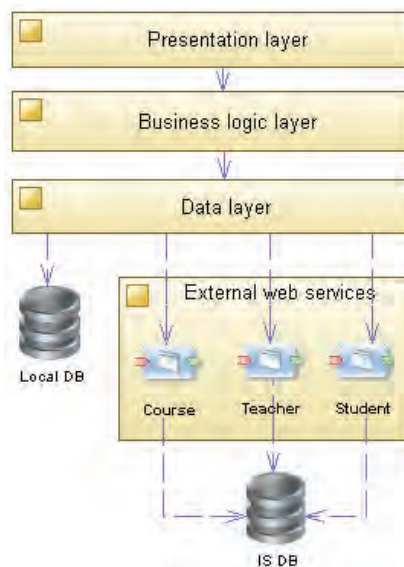

Fig. 1. Architecture of web application for students' survey

Analysis of teachers' ratings becomes more important if the results for one teacher are compared with results for other teachers who were evaluated by the same group of students, or if they are brought in connection with other factors that have a certain influence on teachers' ratings.

Comparison of teacher's ratings with an average ratings of teachers in the same study group, it could be seen that the ratings of teachers to some extent depend on the characteristics of the student population who participated in the survey, or to the performance of teachers in a given period. If the trend of ratings of individual teacher follows the trend of average ratings of all teachers at the same study group, it can be concluded that small variations in the teacher's ratings are probably not the result of degradation or improvement of the performance of teacher, but could be caused by different characteristics of the student population. An example of the individual teacher's ratings on one course unit, compared with an average grade of students on the same course unit and with the average ratings of all teachers evaluated by the same group of students is shown in Fig. 2. It could be noticed that the trends are similar which indicates the that teachers' ratings depend on certain characteristics of the student population. Smaller ratings in academic year 2010/11 are the result of change in scale for the evaluation. Since the 2010/11 academic year, five degrees scale from 1 to 5 is used, while in the previous period we used six-grade scale with ratings of 5 to 10.
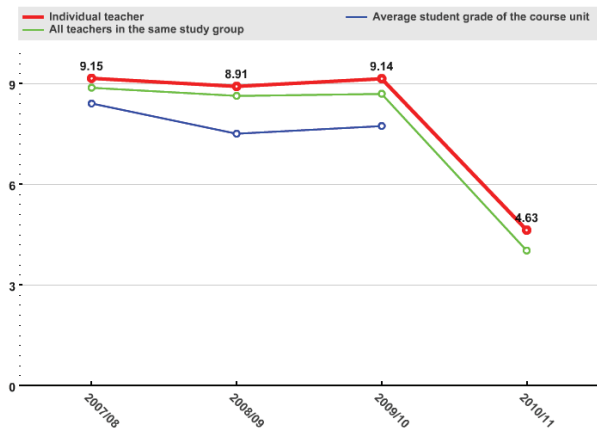
Fig. 2. Teacher's ratings for one course unit compared to student's grades on a given course unit and to overall teacher's ratings for all course units of the same study group

Comparing the trend of ratings of the individual teacher for all his course units, with the trend of overall teachers' ratings of the faculty is shown in Fig. 3. The discrepancy in the trends is understandable considering the fact that a group of students who rated the work of individual teacher differs significantly from the rest of the student population who participated in the survey and rated the work of other teachers.
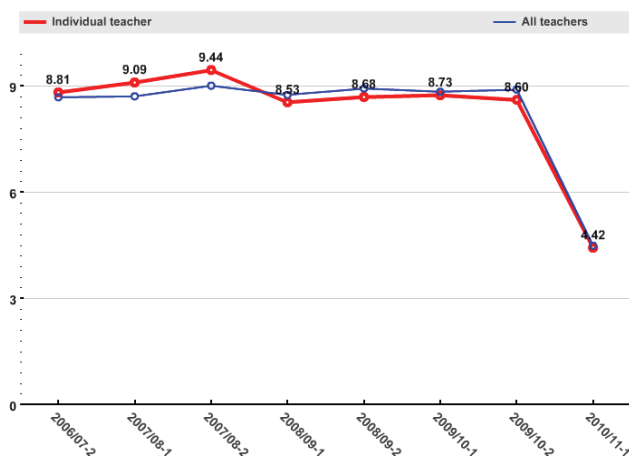

Fig. 3. Individual teacher's ratings compared to overall teachers' ratings

Comparing the trends of teacher's ratings with the trends of certain characteristics of the student population participating in the surveys may reveal additional relationships and dependencies and to allow better analysis of results. Some research shows that the average grade of students participating in the survey affects the ratings of teachers [6]. Also, the average rating of teachers is higher if the study group of students is less. Some of other factors that could influence the average ratings of teachers are teacher age, teacher gender, students gender and so on. In order to analyze the ratings of teachers from some of these aspects, it is necessary to have information about the profile of the student population participating in the survey. Some of the information can be

obtained during the survery process without compromising the anonymity of students, as is the case in the questionnaire with general information about the respondents used at the UES. More reliable and accurate data about the student population could be obtained from official data about students from the UES information system. The data that can be obtained from IS refers to all students who are eligible to participate in the survey. Since the survey process ensures the anonymity of students, it is not possible to establish a direct connection between the characteristics of the student population and the results of the survey, but this information still can be useful for analysing the results.

V. CONCLUSION

This paper describes several software tools used for software support to the quality monitoring at the UES. The main advantage of these tools are capabilities of integration of existing data from various segments of the teaching process and insight into the key indicators of the quality of the teaching process at the university level. By analyzing trends of quality indicators it is possible to monitor the quality of certain elements of the teaching process and conclude about the effects of the measures introduced to improve quality.

In addition to software tools that have already been developed and used at the UES, we mentioned other tools whose development is in progress and whose role is to contribute to automating the process of collection, analysis and presentation of data from the teaching process. These new tools will provide means for monitoring additional quality indicators, which in turn will ensure that the process of monitoring and improving the quality of the UES to become more efficient and effective.

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