Institutional Aspects of Integrated Quality Assurance of Engineering Study Programs at HEI Using ICT

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Institutional Aspects of Integrated Quality Assurance of Study Programs at HEI Using ICT

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Abstract

Informatization of Ukrainian higher education institutions is a priority of the state educational policy, one of the directions of improving HEI's IT infra-structure. The paper aims to develop an integrated quality assurance infor-mation system to enhance institutional aspects of study programs at high ed-ucational institutes. Therefore, there is an urgent need to develop, at the uni-versity level, a standardized website structure designed to assure the quality of higher education with the identification of mandatory elements, for ex-ample, student survey results, rankings of students, lecturers staff, and edu-cational programs, results of verification of the uniqueness of scientific arti-cles and qualification works, review of educational programs for higher edu-cation applicants, e-library, electronic timetable, etc. This will allow us to unify approaches to electronic resource management and accelerate integrat-ing multi-level HEI e-learning resources into a single portal. Paper presented developed quality assurance information system, which allows processing feedback of students for decision making of HEI's authorities.

Keywords

University management system, quality assurance management of HEI, stu-dents' feedback.

1. Introduction

The primary purpose of using IT in the university management of quality assurance (QA) of the education process is to increase applicants' satisfaction with the educational process at HEI through the usage of information systems (IS).

The usage of IT in management, aimed at ensuring the quality of HEI education, should guarantee:

1. In educational activities area: creation of a modern distributed educational and methodical environment of the university; usage of the Internet technologies in the educational process; implementation of projects based e-learning elements; export and import of educational services in the international educational environment.

2. In scientific activities area: representation of the scientific potential of the University in the world information space; providing access of researchers and students to the information resources of world scientific centers; implementation of joint researches and projects as the central part of international consortia.

3. In university management area: managing the processes of collecting, storing, and processing information about the major participants in the educational process, finding and analyzing data; providing automated control over the implementation of decisions; improving planning to assure the quality of education at HEI; increasing of accounting quality and efficiency of usage of financial and technical resources [1].

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Many Ukrainian HEIs are trying to solve the problem of automating the quality assurance management of the educational process by using certain computer programs that allow scheduling classes to determine the level of uniqueness of scientific works and the applicants' satisfaction with higher education from the educational process. However, the effectiveness of each of these developments is insufficient, as there is currently no single systematic approach to managing HEI [2]. Software products from different developers cannot exchange data effectively. That is why more and more HEIs choose to buy or create an integrated management system that allows synchronizing all areas of quality assurance in high education. Therefore, the problem of choosing an appropriate quality management system in the educational process is quite urgent now. The analysis of the existing automated systems of educational process management, finding the ad-vantages and disadvantages of these systems, as well as processing the results of their implementation will solve this problem. To achieve this goal, it is necessary to solve the following problems of the internal quality assurance system of the university:

– to develop models of management and educational activities aimed at assuring the quality of education at the university in the form of a specialized information database;

– to establish and maintain a single support information base for building stu-dent ratings, curriculum, educational programs; approving management decisions to improve the university's educational and methodological activities;

– to create and introduce new forms and methods of quality assurance man-agement at the university based on up-to-date information technologies;

–to reduce essentially the time to receive the information that is needed to ap-prove decisions;

– automate and increase the efficiency of university staff;

– satisfy the information needs of system users;

– to introduce uniform standards for work with electronic documents that take into account the existing regulatory framework and assure the protection, controllability and accessibility of documents;

– develop a system of strategic and operational planning, a system of predicting the development of the university using key performance indicators (KPI) [3].

2. Problem Statement

To solve the aforesaid problems, HEI either uses ready-made software packages or develop their own systems. To choose a particular system, it is necessary to pay attention to the following points: which units of the HEI will be covered by automation; which processes will be automated; components and system type.

The units most often subjected to automation include the basic structural elements of HEI, particularly the university administration, the departments, the lecturer staff, and the students [4]. All of these units are available in the systems, which we review and analyze. In some systems, there are also added accounting and financial departments, library, human resources department, campus, medical center. The main modules presented in the systems include planning of the educational process, management of the educational process, managing the ad-mission campaign, management of information resources, management of financial and economic activity, management of scientific work. Management of the educational process does not differ significantly in all the proposed systems and includes the following elements: scope, planning, distribution and control of the students' level of satisfaction with the educational process, rating of lecturers; creating and maintaining a schedule of educational sessions; accounting and movement of the student population [5].

The paper aims to develop an integrated quality assurance information system to enhance institutional aspects of study programs at high educational institutes (HEI).

3. Literature Survey

Change of higher education structure, development of quality assurance systems and mechanisms enabling the dimension of study program flexibility related to the necessary specific subject

competences [6] represent arguments for the development of institutional design (ID) models, which based on the relationship between institutional rules, learning process, and learning outcomes.

As a process, ID is a systematic educational course development cycle, needs assessment, labor market analysis, design, development, implementation, and results. "Institutional designer" is a person who designs educational courses to fulfill the needs and requirements of external and internal stakeholders. Needs assessment focuses on determining the current state and the desired state and the type of business process on closing that gap [7].

EFQM, the European Foundation for Quality Management, was founded in 1988 to promote self-assessment as a key process for driving business improvement. The EFQM Excellence Model is a diagnostic tool, with a set of criteria generally accepted across Europe, which can be used by HEI to evaluate their strengths, weaknesses, opportunities, and threats and to monitor the progress of strategic actions [8-10]. For HEI it provides a framework for continuous improvement (Fig. 1).

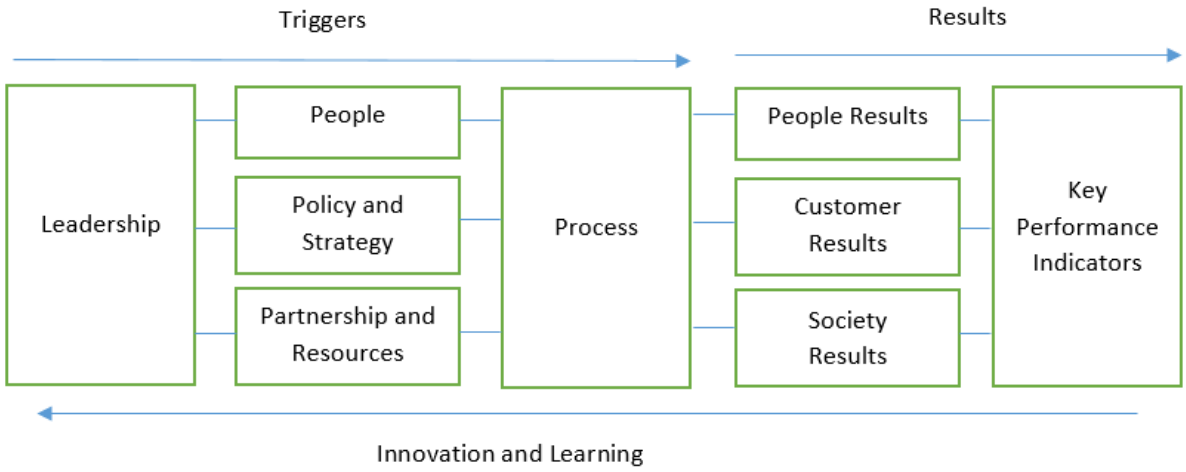

Figure 1: EFQM Excellence Model [9]

Criterion 1. Leadership: The ways in which top management of HEI creates additional values of students, are personally involved in the quality assurance management system, and motivate students to increase their capitalization.

Criterion 2. Policy and Strategy: The systems for ensuring that the needs of stakeholders (employers, students, alumni, academic staff, local authority, par-ents etc.) are incorporated in strategy and tasks of this strategy are developed, deployed, and communicated.

Criterion 3. People: staff, guarantor, support team who are involved in the study process of students.

Criterion 4. Partnerships and Resources: Interconnection of informational (da-tabases, e-library, e-repository), material (labs, equipment, technology), and fi-nance resources.

Criterion 5. Processes: The methods used for managing and improving pro-cesses, including learning, teaching, R&D process, revising of SP, implementation process of SP.

Criterion 6. Customer Results: The KPI of students' perceptions of the organi-zation and other indicators of HEI performance with respect to external stake-holders, including image and the reputation of the HEI's educational services.

Criterion 7. People Results: The measures of staffs' perceptions of the HEI and other indicators of HEI performance with respect to its people, including satisfac-tion, motivation, recognition, involvement, and achievement.

Criterion 8. Society Results: The measures of the organization's performance in satisfying the needs and the expectations of society (local, national, or interna-tional community, accreditation bodies), including public disclosure, environ-mental impact, community involvement, health and safety, and management of such issues.

Like the EFQM Excellence Model, the BQA (Baldrige Quality Award) Criteria Framework is a tool intended to be used by organizations to evaluate their per-formance and monitor the progress of the strategy and process changes (Fig. 2).

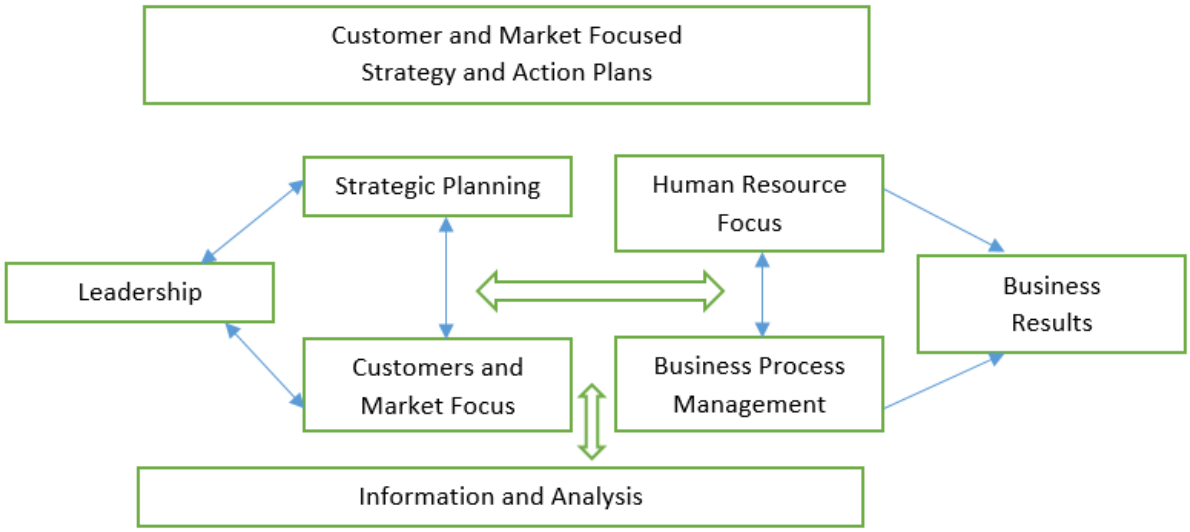

Figure 2: BQA Criteria Framework [10]

HEI has to continuously improve its study programs to stay competitive in the dynamic and changing environment of educational and labor markets. Quality Assurance (QA) is defined as planned and systematic actions implemented within the quality system to provide adequate confidence that educational services will satisfy given requirements for quality (National Qualification Framework and/or Standards of High Education). Quality Management (QA) provides a systematic approach or a model for QA linked with educational quality improvement. Total Quality Management (TQM) requires an organization to go beyond internal stakeholders also to address the requirements of external stakeholders, including employees, employers, regulators, and the local community. The concept of QM and TQM developed over the concept of QA [11]. An example of a systems approach is the definition of quality of education as the "ability of students' knowledge to satisfy stated requirements of accreditation bodies, professional societies, employers, etc." [11].

4. Process input-output satisfaction model with goal and specification

The institutional design of the Process input-output satisfaction model with goal and specification is based on the system approach and includes several elements (Fig.3):

1) goals and specifications of the study program of HEI represent its expected outcomes;

2) to achieve these goals HEI needs to provide all necessary resources, including human, material, informational, and infrastructural resources;

3) the resources need to be accumulated to manage and improve the academic and business processes of the study program, such as program design, program delivery, student selection, student assessment, faculty management, research, and development;

4) the management and improvement of academic processes and achievement of goals can bring satisfaction for the stakeholders under regular monitoring of the program with the intent of continual improvement.

The evaluation and monitoring of SP can use multiple methods or their combinations; among them are audit, self-assessment, benchmarking etc.

Learning analytics (LA) and tools for intelligent analysis of data accumulated in the information systems used by HEIs provide an opportunity to increase the effectiveness of monitoring, management, quality assurance, and evaluation of training for each study program and decision-making. LA tools help managers of HEIs identify courses and programs that more closely match the students' needs and preferences, taking into account the requirement of the labor market and feedbacks of all stakeholders [12]. Some of the tools are standalone software tools, while others are modules included in LMS. Each LA tool is based on a model with a set of indicators, the data of which is extracted from the LMS used at the university.

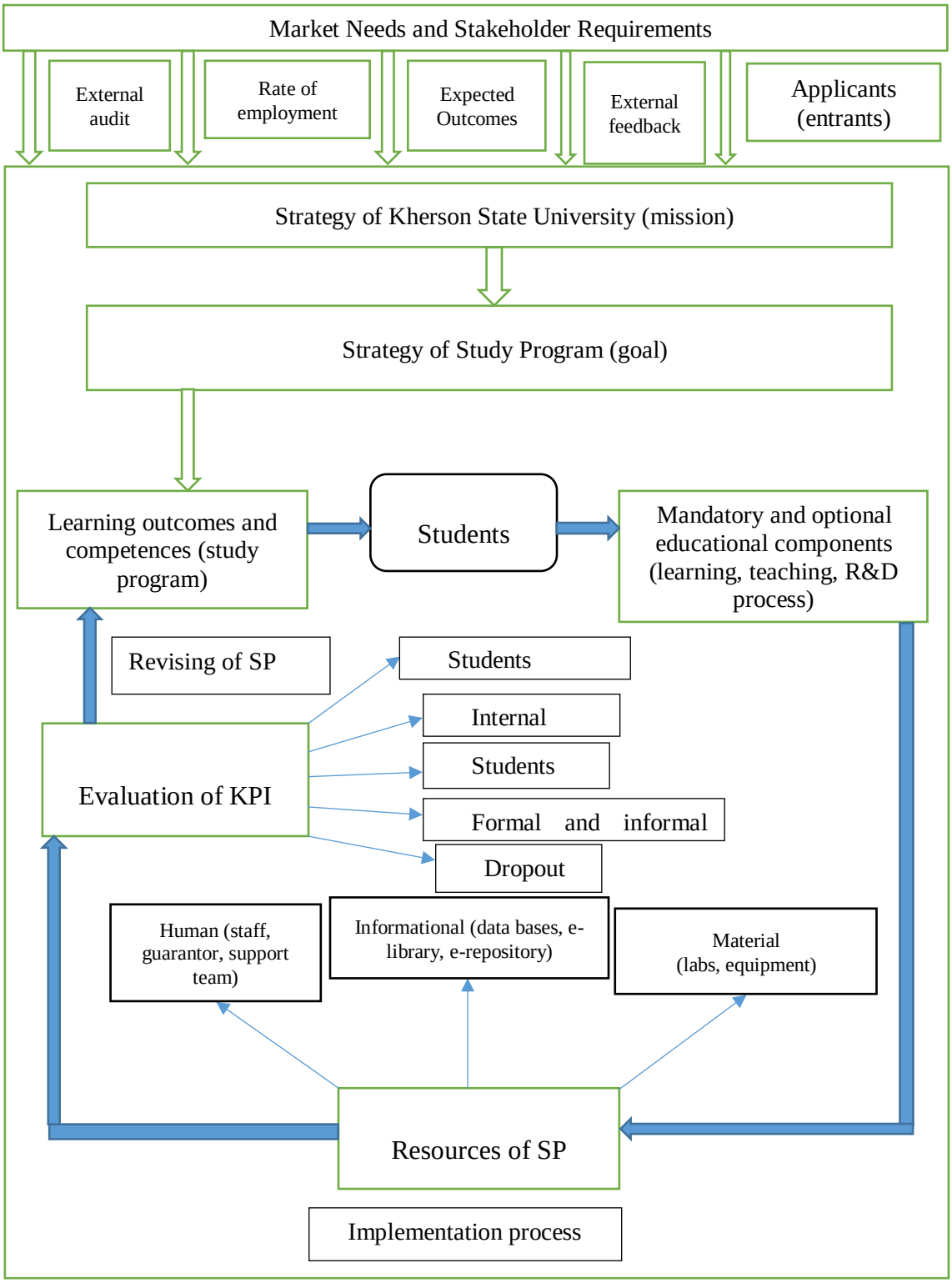

Figure 3: Institutional design of quality assurance procedures at Kherson State University

5. Development, monitoring, and revision of the study programs

The development of a feedback evaluation is a complementary tool towards heightening the comprehensiveness of existing quality assurance mechanisms [13].

Focus groups help to ensure that multiculturalism, diversity, and inclusion are central to the discussion agendas in an HEI [14]. A strong correlation between technical/engineering SPs and good

quality assurance results were found by authors [15, 16], probably because quality expertise is particularly developed in these disciplines.

The key stage of development, monitoring, and revision of the SP include the next steps (fig. 4):

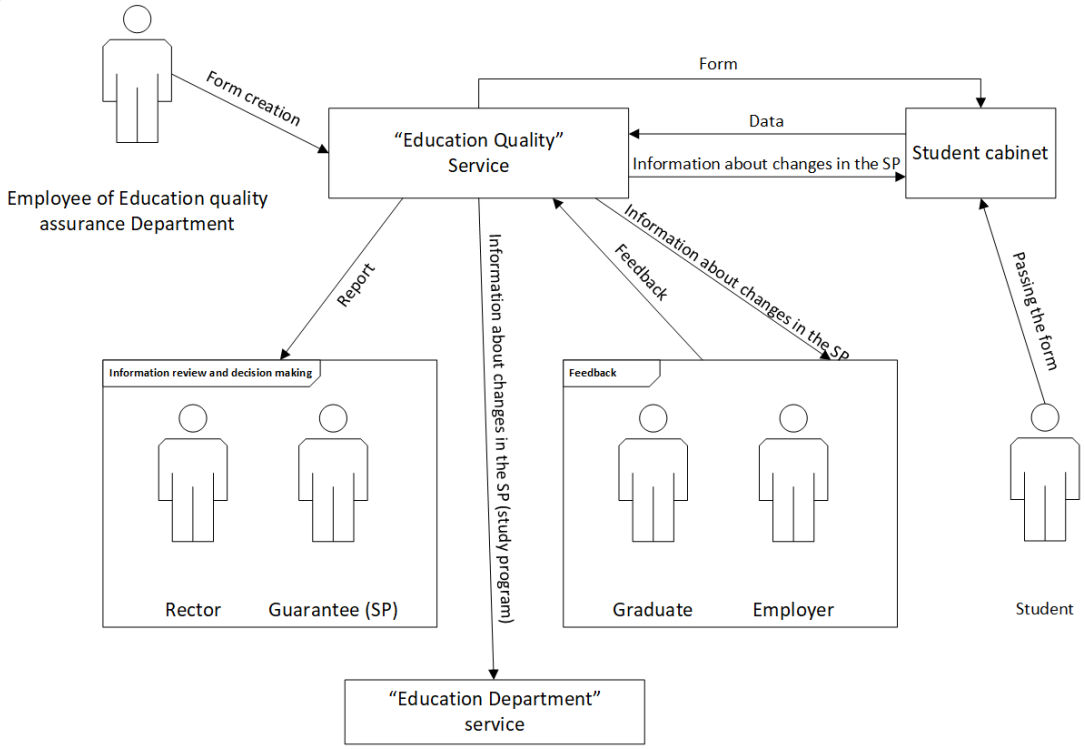

Figure 4: The procedure of development, monitoring, and revision of the study programs

1. **Initiation** – project team (PT), order
2. Determining the needs for a study program SP (project team, employers, graduates, Google surveys)
3. **Analysis of requirements and requests**, Professional Standard (PT, profile specialist through the vision of employers and graduates – list of competencies: LinkedIn electronic competency platform, etc.)
4. **Determination of the list of program competences of the graduates** of SP (universality of OP) – PT, a profile of specialist in the labor market
5. Determination of the list of learning outcomes (LO) – PT, list of LO
6. Definition of the list of educational components (EC) – PT, a draft list of the EC
7. Definition of attestation forms – PT, attestation forms
8. **Determination of the features of the internal quality assurance system of high education** (PT, rating, polls, revising of SP, checking for plagiarism)
9. Consultations on the institutional capacity to provide the SP (scientific, financial, academic, logistical base) – PT, HEI administration, management decisions
10. Development of educational components – PT, staff, descriptions of EC (syllabus etc.)
11. Feedback of students, teachers, graduates after educational activities – types of educational activities, learning outcomes at ECTS.
12. **Revision of SP** (program competencies, program learning outcomes, educational components)

ESG 2015 Standard means that Institutions should monitor and periodically review their programs to ensure that they achieve the objectives set for them and respond to the needs of students and society [10]. These reviews should lead to the continuous improvement of the program. Any action planned or taken as a result should be communicated to all those concerned. Programs are reviewed and revised regularly involving students and other stakeholders. The information collected is analyzed, and the program is adapted to ensure that it is up-to-date. Revised program specifications are published [6] (fig. 5).

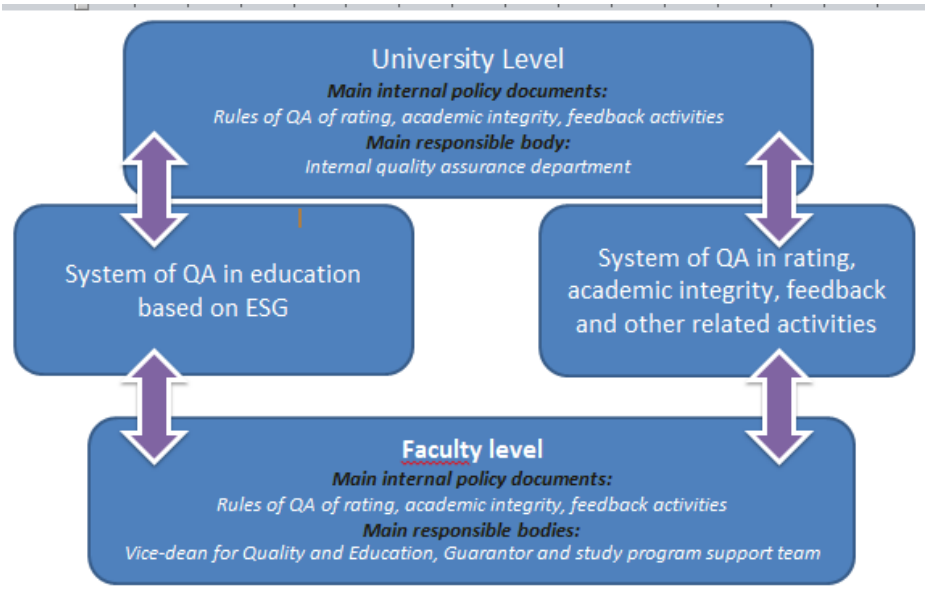

Figure 5: The procedure of quality assurance for study programs on different levels

Measures/procedures

1.1. Monitoring at the level of an individual study component (study program in whole) which provides for:

1) Formation of a KPI of quality of study component of the study program:

- quantitative (student achievement results, the average quality of education, number of sending down students);
- qualitative (feedback from students, teachers, etc.).

2) Determination of indicators' threshold values for which, if achieved (for example, a low percentage of students' quality of education), make it mandatory to monitor the study component at the higher institutional level.

3) Formation of a report about the results of study component monitoring.

4) Monitoring the implementation of the action plan to improve the study component.

Informing all stakeholders about changes to the study program based on the results of the review:

- informing about monitoring of the study program of students, staff, departments providing educational services, and external stakeholders;
- feedback after reviewing the annual monitoring reports of a study program;
- publication of information about monitoring of study programs

6. Results and discussion

The relationship between students' satisfaction with the educational process and the quality of their education for students of economic specialties at Kherson State University is determined using Google forms. Data are obtained from the results of the processing of 724 questionnaires of applicants for the higher education of Economics and Management Faculty (table 1).

Let's consider dependence between the rating of disciplines (dependent variable RD) and the rating of staff (explanatory variable RS) $RD = b_o + b_1 \cdot RS + u$ using data of table 1:

$$RD = -0.61 + 1.09 \cdot RS + u \ (R^2 = 88.3\%) \quad (1)$$

Each unit of RateStaff increase on 1.09 RateDisc (statistically significant, $t(b_1) = 6.15 > t_{cr} = 2.57$). These dependencies are presented in fig. 6.

Table 1
Feedback of students (1 semester 2019-2020), Kherson State University

Code	Specialty	Rating of Disciplines (RateDisc) min=1, max=5	Rating of Staff RateStaff min=1, max=5	Quality of education of bachelors min=1, max=100
051	Economics	4,39	4,57	33,3
073	Finance, banking and insurance	4,24	4,34	32,4
241	Hotel and restaurant business	4,31	4,62	11,7
073	Management	4,46	4,71	26,9
292	International Economic Relations	3,87	4,23	36,4
076	Entrepreneurship	4,42	4,56	16,7
242	Tourism	3,80	4,07	26,7

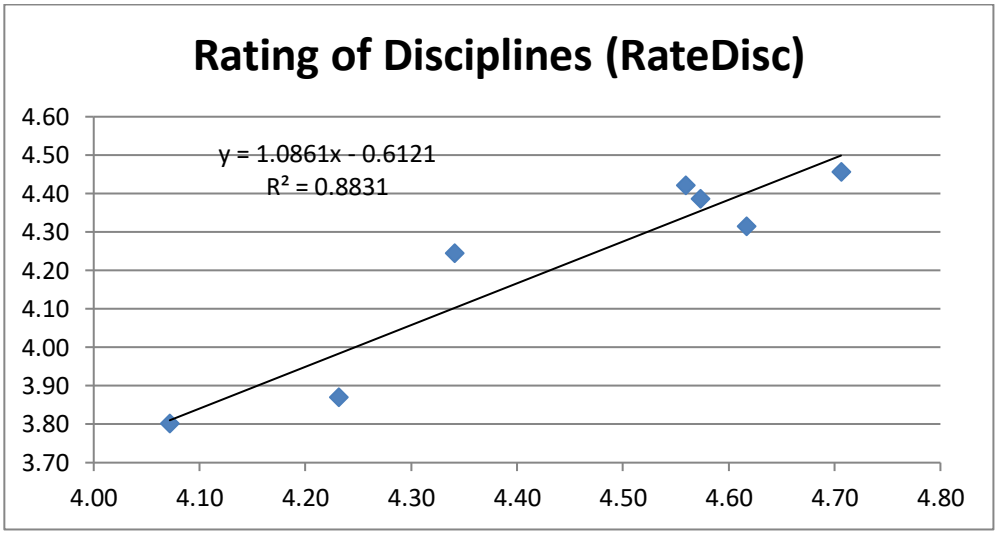

Figure 6: Impact of rating of staff on rating of disciplines

If we transform absolute values (table 1) in the relative index (table 2) we can get regression in the following form

$$lnRD = -0.29 + 1.16 \cdot lnRS + u \ (R^2 = 88.6\%) \quad (2)$$

It means that each 1% increasing in the rating of staff will increase by 1.16% rating of disciplines.

But for disciplines (table 3), which cover specific subject competencies and generic competencies, we got the different motivation. Rating of staff has a direct impact on the rating of courses ($RD = -1.26 + 1.24 \cdot RS$, $R^2 = 84.6\%$), which cover specific subject competencies. At the same time rating of staff has no impact on the rating of courses ($RD = 3.0 + 0.25 \cdot RS$, $R^2 = 4.2\%$), which cover generic competencies. In our opinion, the motivation of students to study discipline which covers generic competences is not determined by the personality of the teacher. One reason for this is that most courses that cover general competencies are mandatory to study. Based on the feedback results at KSU from 2021-2020, it is planned to make these disciplines optional ones.

Key role of IAS and Google forms: collects, store and visualize all the data related to students and their achievements, study programs and individual courses (especially learning outcomes),

schedule of classes, and various related statistics important for the management of the university, financing and quality assurance.

Table 2
Log values of students' feedback (1 semester 2019-2020), Kherson State University

Code	Specialty	Ln(RateDisc), %	Ln(RateStaff), %	Ln(Quality), %
051	Economics	1,48	1,52	3,51
073	Finance, banking and insurance	1,45	1,47	3,48
241	Hotel and restaurant business	1,46	1,53	2,46
073	Management	1,49	1,55	3,29
292	International Economic Relations	1,35	1,44	3,59
076	Entrepreneurship	1,49	1,52	2,82
242	Tourism	1,34	1,40	3,28

Table 3
Feedback of students for disciplines which cover specific subject competences and generic competences (1 semester 2019-2020), Kherson State University

Code	Specialty	specific subject competences		generic competences	
		Rating of Disciplines (RateDisc)	Raying of Staff (RateStaff)	Rating of Disciplines (RateDisc)	Raying of Staff (RateStaff)
051	Economics	4,47	4,62	4,09	4,42
073	Finance, banking and insurance	4,31	4,40	4,06	4,17
241	Hotel and restaurant business	4,50	4,56	3,83	4,77
073	Management	4,49	4,72	4,33	4,65
292	International Economic Relations	3,57	4,11	4,34	4,43
076	Entrepreneurship	4,43	4,55	4,40	4,61
242	Tourism	3,82	3,97	3,76	4,29

7. Conclusions

The key stage of development, monitoring, and revision of the SP includes initiation, analysis of requirements and requests, determination of the list of program competencies of the graduates, determination of the features of the internal quality assurance system of high education, revision of study program. Programs are reviewed and revised regularly involving students and other stakeholders. The information collected is analyzed, and the program is adapted to ensure that it is up-to-date.

Using our developed quality assurance information system, we got that each unit of the rating of staff increases on 1.09 rating of disciplines. But for disci-plines, which cover specific subject

competencies and generic competencies, we got the different motivation. The rating of staff has a direct impact on the rating of courses, which cover specific subject competencies. At the same time rating of staff has no impact on the rating of courses, which cover generic competencies. In our opinion, students' motivation to study discipline that covers generic com-petences is not determined by the teacher's personality. The main reason for this is that most courses that cover general competencies are mandatory to study. Based on the results of feedback at KSU from 2021-2020, it is planned to make these disciplines optional ones.

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