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The Validity of a Design Technology for a Higher Education Quality Assurance System Based on the EFQM Model

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ABSTRACT

In current conditions, higher educational institutions have to develop innovative mechanisms of education quality assurance independently. One such mechanism is the implementation of the European Foundation for Quality Management (EFQM) model, although the 9001:2001 International Organization for Standardization (ISO) model is widely implemented in the higher education system of Kazakhstan. International Organization for Standardization (ISO) model is widely implemented in the higher education system of Kazakhstan. In-depth theoretical and methodological studies developed a design technology for a quality assurance system. The purpose of this study is to confirm the validity of this technology, which is why the study sets the following tasks: 1) to determine the validity criteria for the developed technology; 2) to show that the developed technology meets the validity criteria. An important result of this study is that it substantiated the criteria of the selected types of technology validity: construct, criterion, and content. The study proved that the developed technology met the criteria of validity, which was the main result. This allows recommending higher educational institution in Kazakhstan to implement this technology.

Keywords: higher education, validity criteria, educational management, ISO model, Kazakhstan

INTRODUCTION

Education quality assurance is regarded as one of the most urgent problems worldwide (Ewell, 2010; Ingvarson & Rowley, 2017). One can note that the Bologna process in Europe is probably the most visible multinational transformation in the world today and, of course, has a quality assurance dimension discharged through such multinational organizations as the European Association for Quality Assurance in Higher Education formally the European Network for Quality Assurance. Similar regional networks have been established in Asia, as well as in Central and South America abilities (Craft, 2003). These tendencies reflect growing student and graduate mobility and an emerging set of global standards for graduate abilities (Padro, 2015; Groen, 2017). They are particularly relevant to developing countries (Boccanfuso, Larouche & Trandafir, 2015).

According to the State Program for Development of Education in the Republic of Kazakhstan in 2011-2020 (2011), higher educational institutions will be granted academic, financial, and administrative autonomy. Therefore, higher educational institutions should already be developing innovative mechanisms of education quality assurance. One such mechanism is the implementation of the EFQM model. The purpose of this model is to determine areas for improvement that would increase the company's competitive performance; therefore, the result of the model's implementation is the assessment of the level of readiness as the degree of approximation to the

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Contribution of this paper to the literature

- The paper describes the validity of International Organization for Standardization model.
- Analysis of personnel quality as well as educational facilities quality is presented by the authors on the basis of questionnaire survey in 3 Kazakh universities.
- This research can be regarded as basis for further investigations on higher education quality assurance.

Table 1. Comparison of quality assurance models

ISO 9001:2001 model	EFQM model
– *Quality assurance policy and procedure.* – Constant control of the activity of the educational institution based on a periodical analysis of the results of its activity. – Quality of students. – Quality of academic staff. – *Quality of student support and resources.* – Information support. – Public information.	The model incorporates two groups of criteria – "Possibilities" and "Results". The "Possibilities" group includes the following criteria: 1) leadership; 2) *politics and strategy*; 3) employees; 4) *partnerships and resources*; 5) processes. The "Results" group includes the following criteria: 6) customer related results; 7) employee related results; 8) business related results; 9) key results.

perfect (ideal) company within the accepted model with a list of areas for improvement that require changes (European Foundation for Quality Management).

The analysis of the ISO 9001:2001 model, which has been implemented in the higher education system of Kazakhstan, allows concluding that it is based on the notion of "what exactly an organization should be doing". The main method in ISO standards is audit, which is why the results of this method simply state the compliance or noncompliance and gives a list of inconsistencies to be eliminated (GOST R ISO 9001-2008). These standards provide only for a qualitative assessment and require filling in multiple documents at that. They force educational organizations to focus on the audit results and timely elimination of discovered flaws. This hinders the improvement of educational activities, to a degree.

Nevertheless, the ISO 9001:2001 model currently shows a tendency of expanding its scope of application. The fact of the matter is that the standards of both accreditation agencies in Kazakhstan that are included in the National Register are also based on the ISO model. Another manifestation of this tendency is the demand for practice-orientated monographs in higher educational institutions (Minzhayeva, 2009).

The features that distinguish the EFQM model from the ISO 9001:2001 model were determined based on comparison criteria (**Table 1**) (Nabi, 2013a).

As the table shows, only two criteria match (criteria with a matching concept are highlighted in italics). The ISO 9001:2001 focuses on constant control of the activity of the educational institution based on a periodical analysis of the results of its activity, while the EFQM model takes into account the possibilities of leadership, personnel, and correct choice of strategy, politics, and partners.

The developed methodological aspects of system design, which provide the required theoretical rationalization of the design technology, should help to develop a mechanism for the design of a higher education quality assurance system. In the context of this study, a design mechanism is a means of describing the relationships that emerge during the interaction of subjects and objects of design during the design process, as well as implementing and assessing the results. This working definition can be specified, but at the current stage of the research, it reflects the essence of further steps. In any case, it would be difficult to confirm the validity of the logic of further studies without defining the terms.

Design is a multifaceted term. First of all, it includes a system of goals, since the design mechanism should be focused on achieving goals. At that, it is necessary to determine the links and relations between the elements of the designed object, to assign the tasks and functions of each element, and identify the responsibilities and powers of the subjects of design during the development and as a result of design.

This multifaceted nature of the mechanism forces using a set of methods. Therefore, it is necessary to proceed from a combination of scientific methods with extensive expert and analytical work, the study of Kazakh and foreign experience, and close cooperation of the developers, implementers, and users of the designed object. The design mechanism should be based on a concise formulation of the design goals. Therefore, it is necessary to stick to the formula of "clear understanding of goals first, development of a mechanism to achieve said goals later".

The development of the mechanism includes the determination of criteria and indices of design effectiveness and a rationalization of the technology used to design the system of higher education quality assurance based on the EFQM model. The implementation of the mechanism requires developing a technique for collecting empirical data for the experimental work, which should be tested in higher educational institutions of Kazakhstan; this should be followed-up by a preparation of recommendations regarding the use of the results of studies in the practice of higher educational institutions based on the confirmation of the technology's validity. According to the most common definition cited at the Russian version of Wikipedia, *validity* is the rationality and applicability of research methods and results in specific conditions. At this stage, this definition is taken as a basis.

Thus, despite the general trend of expanding the scope of use of the ISO model in education quality assurance systems, the EFQM model is preferable from the perspective of Kazakhstan system's integration into the European educational space. At the same time, it is worth mentioning the major advantage of the ISO model, which is that it features a standardized validation of technological processes, which the EFQM model lacks. Therefore, the problem arises regarding the confirmation of the validity of a technology that is developed based on this model.

METHODS

The goals of the study require determining the methods that will be used to assess the effectiveness of design. Assessment methods currently in use mostly focus on the functional aspect with the regulation of processes, rather than their results, being the cornerstone. Researchers and developers should rely on the system criteria and indicators that are based on the initial definition of the design goals system, which then sets the tasks and determines the scope of the design process. The following methods of assessing the effectiveness of educational system design should be distinguished: analogy method, expert method, goal structuring method, and modeling method.

No single method has been created yet that would formalize variables, collect data or assess results. In this case, the personal experience of the researcher is crucial. Therefore, based on personal experience, the offer is to use a set of criteria and indices that characterize the effectiveness of the design of a quality assurance system. The final criterion of effectiveness, in comparison to various versions of the project, *in our opinion*, is the fullest and most sustainable achievement of goals set in the project. However, it is very difficult, even impossible in case of social systems, to bring this criterion to simple indices that would be practically useful and linking each process with its final results. Therefore, the set of effectiveness criteria for the design of a quality assurance system should be formed with regard to the correspondence of the results that are being achieved to the set goals and the correspondence of the system's operation characteristics to the set requirements to its scope and results, i.e. the results of design are assessed from the perspective of effectiveness, while effectiveness is assessed by comparing the result and the efforts made to achieve it.

The following methods were used to determine the indices to be included in the process sheet of the design of the quality management subsystem, inherent quality assurance subsystem, and a subsystem for confirming the quality of the EFMQ-model-based higher education quality assurance system:

1) questionnaire survey to collect information;
2) collection of factual material (figures, indices, financial indicators);
3) analysis and determination of strengths and weaknesses;
4) results of official scoring, commission inspections, attestations, and accreditations.

When organizing the questionnaire survey, it is very important to formulate questions in a way that would ensure that the answers to said questions correspond to what one is trying to find out. Many factual data can be acquired from higher educational institution reports, which are compiled in bulk for various agencies and are posted of official websites, featured in ads, etc. The only thing required is to structure this material and select only the parts of it that correspond to the goals of the study.

Pedagogical studies usually deal with weakly formalized and non-numerical information, which is often unsuitable for methods from exact sciences, for instance, mathematical statistics methods. Using mathematical methods in pedagogy is a current trend that produced a separate scientific field – pedagogical qualimetry. At the same time, the investigation of pedagogical problems traditionally uses general research methods: systems and activity approach, modeling, expert assessment, thought experiment, etc. The group expert assessment method is one of the most common means of formalization of weakly formalized information. Despite having been economic research method at first, it is now used in pedagogical studies. In particular, it was used in the development of a scientific project titled "Scientific and Methodological Framework of the Design of a Higher Vocational Education Quality Assessment Model" (Nabi, & Mendigaliyeva, 2006).

In the context of pedagogical studies, the group expert assessment method consists in specially selected experts conducting an intuitive and logical analysis of a pedagogical problem with a quantitative and qualitative assessment of their judgments and subsequent treatment of obtained data via mathematical statistics methods (Tatar, & Oktay, 2006). In order to improve the reliability of the expert assessment and eliminate the influence of the subjective opinions of those who select the experts, the survey of experts, treatment of results, and other operations should be carried out with regard to the requirements of appropriate state standards (Stephenson & Yorke, 2013). After the group of experts is surveyed, the results are treated. The raw information set to undergo treatment always features numerical data that express the experts' preferences.

Assume *m* experts assessed *n* objects. Then the results of the assessment can be presented in the form of an expression – x_{ij}, where *i* is the object number and *j* is the expert number. When assessing objects via direct assessment, the x_{ij} values are numbers from a certain number line interval. In order to obtain the group assessment of objects, one can use the mean value of the assessment

$$x_{ij} = \sum_{j=1}^{m} x_{ij} f_j \qquad (i = 1,2\dots,n)$$

$$\sum_{j=1}^{m} f_j = 1 \tag{1}$$

where f_j are the expert competence coefficients (expert competence coefficients are normalized values).

Expert competence coefficients can be calculated based on the results of expert assessment on the assumption that the competence of experts should be assessed according to the degree of correspondence of their assessments with the group assessment of objects.

The algorithm for calculating expert competence coefficients has the form of a recurrent procedure:

$$i = 1,2\dots,n \quad (j = 1,2,\dots m) \quad (t = 1,2,\dots)$$

$$x_i^t = \sum x_{ij} f_j^{t-1} \tag{2}$$

$$S^t = \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} x_i^t \tag{3}$$

$$f_j^t = 1/S^t \textstyle\sum_{i=1}^{n} x_{ij} x_i^t; \qquad \sum_{j=1}^{m} f_j^t = 1 \tag{4}$$

Calculations start at t=1. In formula (1), the initial values of competence coefficients are identical and equal f=1/m. Then, according to formula (1), the first approximation group expert assessments equal the arithmetic means of expert assessments

$$x_i' = 1/m \sum_{j=1}^{m} x_{ij} \qquad (i = 1,2,\dots n)$$

Then the S′ value is calculated according to formula (3)

$$S'' = \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} x_i$$

and the values of first approximation competence coefficients are calculated according to formula (4).

$$f_j' = 1/S'' \sum_{i=1}^{n} x_{ij} x'$$

By using first approximation competence coefficients, it is possible to repeat the entire calculation process according to formulas (2)…(4) and obtain second approximations x''_i, S'', f''_j.

The group expert assessment method was used to determine the dependency of significance of indicators in the questionnaire, with a view to assessing the quality of personnel. Experts were offered questionnaires and asked to assess the significance of this or that attribute of professional and personal qualities of teachers. An electronic table was developed that allowed obtaining the significance of each attribute of each professional and personal quality.

When designing the quality management subsystem during preliminary preparation, the following was done:

a) requirements to the quality of activity were determined based on the analysis of requirements to the quality of education set in the European educational process;

b) the level of motivation of the personnel to improve the quality of education was determined. Questionnaires were used to that end.

At the engineering design stage, the employers' satisfaction with the questionnaire survey method was monitored.

The level of students’ motivation was determined according to the method described in. Although this method was designed for the 11th grades of secondary schools, it is acceptable for the purpose of this study, since the survey involved freshmen. Students were offered to read each unfinished sentence and each answer option thereto carefully and underline two answers that corresponded to their personal opinion. The questions identify cognitive and social motives: broad social, narrow social, avoidance of trouble, approval orientation. The domination of cognitive or social motives was analyzed.

The level of teachers’ motivation to improve the quality of pedagogical activity and the reasons that hinder said motivation were determined using questionnaires. The opinion of the academic staff regarding innovative activity, their proficiency in advanced educational technologies, and their level of implementation in pedagogical practice was determined (Semenova, 2009). In addition, the teachers assessed the quality of educational facilities at their disposal (classrooms, laboratories, ICT rooms, educational equipment, etc.).

The design of the inherent quality assurance subsystem during preliminary preparation involved the following:

a) analysis of personnel quality;

b) analysis of educational facilities quality;

c) analysis of educational technology quality.

The analysis was carried out via questionnaire survey. There are many methods that could be used to assess personnel. Considering the qualimetric approach taken in this study, quantitative assessment methods were used. In order to improve the validity of data, participants of assessment procedures were assured that the results would remain confidential. This increases the objectiveness of the assessment and does not create conditions for distrust in the assessment results and the assessors (managers, employees, etc.). In addition, the criteria themselves should be unambiguous and understandable so as not to cause suspicion that the management wishes to acquire certain data in a roundabout way. All the above will facilitate the active participation of personnel in the assessment processes and subsequent elimination of discovered flaws.

Creating an assessment system that meets all the requirements (objectiveness, accuracy, simplicity, etc.) is a difficult task, while existing system all have their strengths and weaknesses. We adapted known methods (Personnel assessment) to the conditions of higher educational institutions. The distinguishing feature of the adapted method is that it involved the head of the department, the colleagues of the assessee, and the assessee him- or herself in the assessment. The combination of these forms of assessment allows increasing the objectiveness of assessment while simultaneously concealing the specific assessor.

The engineering design stage included a monitoring of the implementation of educational and pedagogical technologies with regard to quality requirements within the framework of marketing, competency-based approach in results-oriented education, conditions for achieving academic mobility, innovations, and improvement and update of educational programs. The monitoring used the results of higher educational institution accreditation.

The design of the quality confirmation subsystem during preliminary preparation involved the analysis of criteria and indices of education quality used in the European educational space. The engineering design stage involved the following:

a) the results of higher educational institutions’ activity in respect to customers, personnel, and business, as well as the key results of their activity were analyzed;

b) the compliance or noncompliance with the criteria and indices of education quality used in the European educational space was determined.

The results of higher educational institutions’ activity in respect to customers, personnel, and business, as well as the key results of their activity were determined by studying the reports on institutional accreditation and processing them using the GOA Basic Assessment Education ver. 2.1. software. This software is convenient because it not only counts the points automatically, but also gives recommendations on how to improve this or that index.

It is necessary to answer the questions in succession across nine blocks that correspond to nine blocks of criteria from the EFQM model (**Figure 1**). The software counts the points and generates a diagram according to the calculated points.

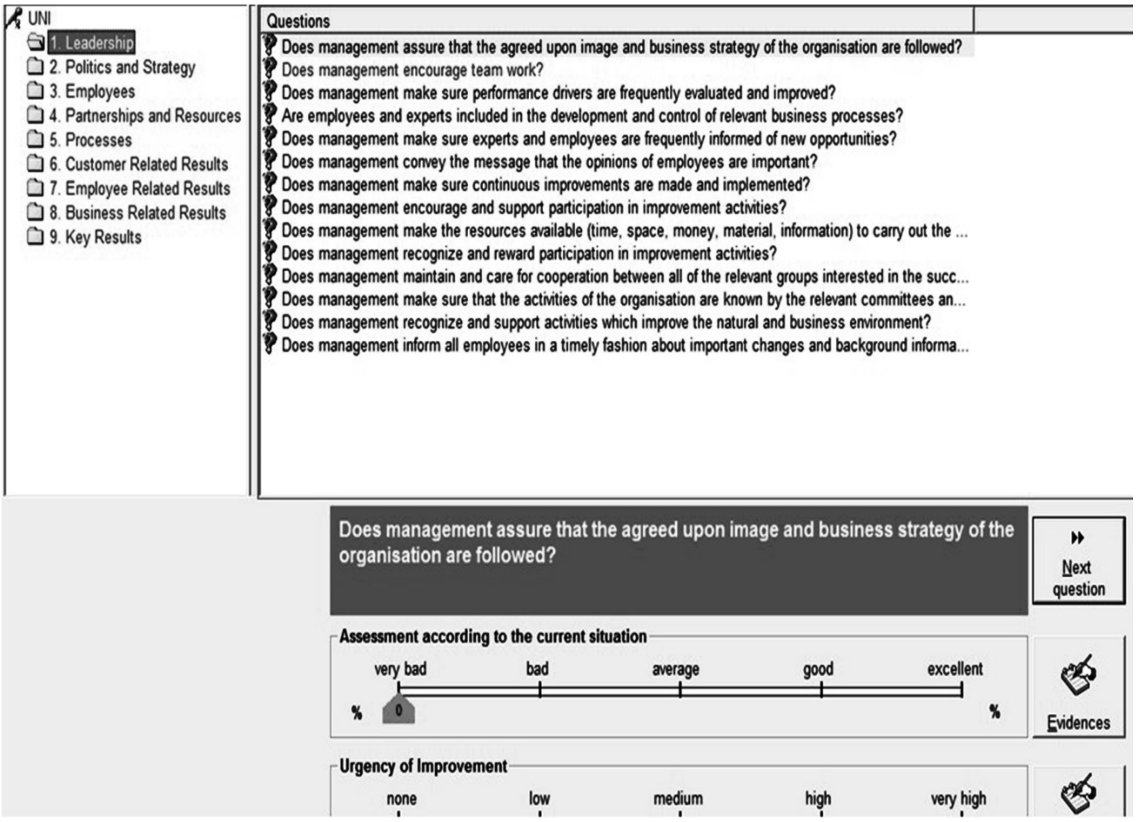

Figure 1. Software interface

The compliance with criteria and indices of education quality used in the European educational space was determined via special calculations. Criteria were calculated based on a RADAR assessment matrix. The following elements of the matrix were distinguished: Approach, Development, Assessment and Overhaul, and Results. Each element has its attributes (McCarthy, Greatbanks & Yang, 2002).

Obtained data are entered on the point calculation list, in which the number of points is calculated as an arithmetic mean across all the components of this criterion. Points are calculated in percentage. In the "Sum" column, percentages for components are summed up; the obtained sums are divided by the number of components, for instance, for the "substantiation" attribute, it is 3, for the "integration" attribute – 2, etc.

The total number of points is calculated. It is necessary to enter the number of points for each sub-criterion and multiply the number of points by the respective factor to obtain the resulting points for each sub-criterion. Then it is necessary to sum up the resulting points across all criteria to obtain the total number of points.

The quality of the educational technology was analyzed according to the criteria that can be distinguished as those that were characteristic of good planning of classes (Laurillard, 2013).

RESULTS

Purpose and Tasks of the Study

The purpose of this study is to confirm the validity of a design technology for a higher education quality assurance system based on the EFQM model, which is why the study sets the following tasks:

1) To determine the validity criteria for the developed technology;
2) To show that the developed technology meets the validity criteria.

The novelty of the study lies in the following:

1) A technology for designing a higher education quality assurance system based on the EFQM model was developed, which is unparalleled;
2) Validity criteria were determined for the developed technology for three types of validity. At that, in the content validity, the criterion that is applicable to technological processes in pedagogical systems was substantiated for the first time in pedagogical theory;

3) The developed technology was proven to meet the validity criteria.
4) The introductory section of the paper featured a working definition of validity to outline the terms in use.

However, there is a broader definition of validation and validity, for instance:

1) Validation: "To establish the soundness, accuracy, or legitimacy" (Validation Dictionary of the English Language);
2) Validity is the extent to which a concept, conclusion or measurement is well-founded and corresponds accurately to the real world. The word "valid" is derived from the Latin validus, meaning strong. The validity of a measurement tool (for example, a test in education) is considered to be the degree to which the tool measures what it claims to measure; in this case, the validity is an equivalent to accuracy (Brains et al., 2011);
3) Validity is essentially a comprehensive characteristic that includes information about whether or not a method is suitable for measuring that for which it was created on the one hand and how effective, efficient, and practical it is on the other hand.

The value of the latter definition lies in its emphasis on the necessity of a pragmatic validation of methods, i.e. assessment of their efficiency, effectiveness, and pragmatic significance.

Researchers distinguish several types of validity, for instance, study (Validation) notes construct, content, criterion, experimental, diagnostic etc. validities, while study (Safontsev, & Fedotova, 2014) distinguishes content, construct, and criterion validity when investigating the validity of pedagogical objects; at that, the author of the study considers modularity, diagnosticity, and qualimetricity to be the criteria of the construct validity of an educational system. Content validity is a non-statistical type of validity that involves "the systematic examination of the test content to determine whether it covers a representative sample of the behavior domain to be measured" (Validation).

It is worth noting that the above definitions of the term "validity" are mostly related to tests (psychological tests, pedagogical tests to determine the level of knowledge, etc.). In regard to design, validity is regarded only in the context of quality management. In ISO, validation is defined as a procedure that gives a large degree of confidence that a specific process, method or system will consistently lead to results that meet the set criteria of acceptability; in particular, validation of technological processes is carried out to prove and provide documented evidence that the process (within the set parameters) is repeatable and produces expected results. The "Resulting Output" of a design process is a project – a product, which note 2 to the term "product" in Paragraph 3.4.2 of ISO 9000:2005 denotes as "software". Information, rather than the material component, presents the main value for the consumer. Requirements of Section 7.3 of ISO 9001:2008 mention the need to verity and validate the result of the design process, i.e. the project itself. Project validation is often misunderstood, since the concepts of the intended purpose of the project and the actual output based on the project are mixed. To validate the project means to confirm the ability to use this project as input requirements for production processes.

Based on this notion, it is possible to conclude that the content criterion of validity is the confirmation of the ability to use this project, which can be expressed in the following parameters:

1) Match of data obtained from higher educational institutions with different statuses;
2) Approximately identical level of designers, i.e. those who realize the project;
3) Similar skill level of experts involved in the obtainment of raw data.

These parameters are based on the accepted methods of experimental work. Their definition will be the most labor-intensive work, since it requires collecting experimental data from several higher educational institutions and said institutions have to be dissimilar at that. If the data for dissimilar higher educational institutions are consistent and, in some cases, similar, then this will be indicative of the fact that the developed technology is applicable regardless of the status of the higher educational institution. Such comparisons have not been made to date, which is why the results of this study may be interesting to both Kazakh and foreign readers. This is one of the features of this study.

The criterion validity was taken based on the opinions of authors of (Melnikova & Khoroshilov, 2014), who believe that the objectiveness of any study comprises of validity and reliability, with validity being divided into three types: objective, instrumental, and theoretical, while the key strategy for achieving validity is to divide the study into several phases and clearly document all actions and conclusions for each phase.

Thus, an important result of this study is that the validity of the technology will be confirmed in three aspects according to the following criteria:

1) Construct validity - modularity, diagnosticity, and qualimetricity;
2) Criterion validity – division of the study into several phases and clear documentation of all actions;
3) Content validity – the ability to use this project in similar conditions.

It is worth noting that while the first two types include known criteria, the content validity, for the first time in pedagogical validity theory, substantiated the criterion that is applicable to technological processes in a pedagogical system.

The validity of the technology is confirmed based on these criteria.

A Design Model for the Higher Education Quality Assurance System

The theory of pedagogical design includes a prognostic model, a conceptual model, a pragmatic model, an instrumental model, a monitoring model, and a reflexive model. In terms of their construction method, models are divided into image, symbol, and image-symbol ones. Many researchers gave the following definition: a *model* is an artificially created object in the form of a scheme, physical constructions, symbolic forms or formulas, which is similar to the studied object or phenomenon and reflects or recreates the structure, properties, interconnections, and relationships between the elements of said object in a simpler fashion (Knapp, 2014). J. Šedivý (2013) mentions that "*Modeling* is a method that is often used in professional and scientific practice in many fields of human activity. The main goal of modeling is not only describing the content, structure and behavior of the real system representing a part of the reality but also describing the processes. The process can be understood as series of transformations that changes the input values to output values. From the system point of view the process is dynamic system in which the values of the characteristic of the system elements are changed under the influence of the external elements. The models are always only approaching of the reality, because the real systems are usually more complex than the models are" (Šedivý, 2013).

The construction of the model, the specification of the dependency between the main elements of the studied object, and the determination of the parameters of the object and the model structure was based on the regularities of pedagogical modeling.

Pedagogy mostly models multifactorial phenomena. Debates concerning the possibility of modeling complex social phenomena are ongoing and, probably, endless. This is related to the fundamental problem of completeness of each constructed model. No model, regardless of how complex it is, is capable of giving a complete understanding of the studied object and accurately predicting its development or describing its motion trajectory in any proper space. This forces researchers to balance on the edge of completeness and validity when constructing models. Certain promise is found in the construction of a complex of models that describe various factors of development of an educational system. It is worth emphasizing that this implies a complex, rather than a random set of models, which would make for an eclectic, arbitrary, and chaotic description. The professionalism of a researcher manifests in the construction of a holistic complex of models.

In this case, the matter at hand is a complex of models, since three models of subsystems (**Figure 2**) were developed in addition to the structural model of design of a higher education quality assurance system. Furthermore, assumptions regarding the means of achieving goals were made and criteria of assessment of expected results were determined. Assessments were made based on quantitative values, since *the authors believe* that qualimetry can be limited to investigating the "measurement" concept, while the very nature of the problem of product quality measurement necessitates using quantitative methods to describe quality (Nabi, 2013[b]).

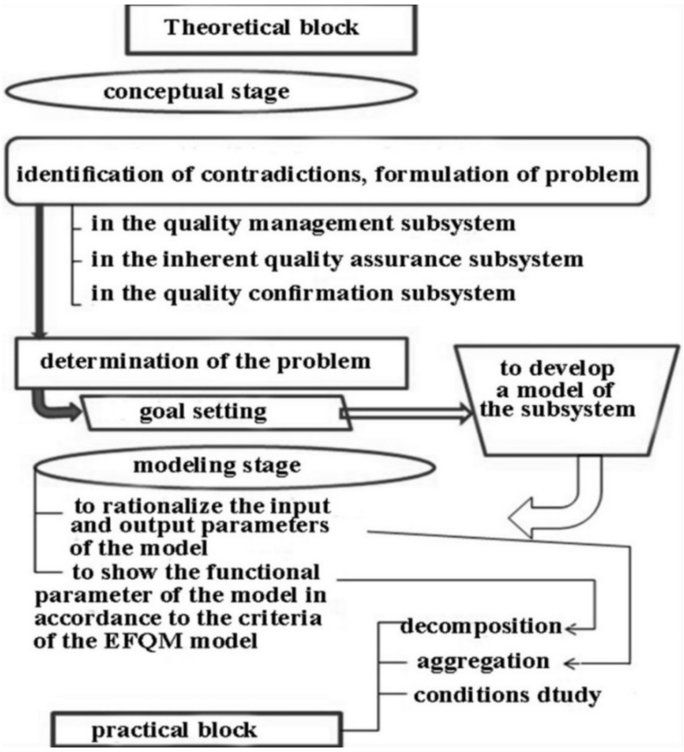

Figure 2. Structural model of design of a higher education quality assurance system

The developed structural model of design of a higher education quality assurance system based on the EFQM model (Nabi, 2014[a]) is novel and prognostic, since:

a) it allows distinguishing the components of the model and determining their hierarchy, interconnection, and content: the identification of contradictions determines the problem, which determines the goal of design. The identified contradictions and problems of education quality assessment allowed formulating the problem of design: it is necessary to elaborate the theory and practice of design of quality assurance systems despite the limited capabilities for completing the task via conventional means. This problem was solved in the developed models:
    - quality management subsystem;
    - inherent quality assurance subsystem;
    - quality confirmation subsystem.
b) it shows the direction for further studies, since the practical block involves a development of a specific mechanism for the implementation of developed models.

The Design Technology for a Higher Education Quality Assurance System based on the EFQM Model

The developed method for selecting methodological approaches is unparalleled: five stages of the method allow determining the parameters for the analysis and comparison of approaches, determining the strengths and weaknesses of each approach, and selecting them with regard to the four features of the EFQM model that were determined during previous studies.

The interdisciplinary approach was taken when rationalizing the principles of design of a higher education quality assurance system based on the EFQM model and developing methodological approaches (Nabi, 2014[b]). Another original feature of this study is the discovered compliance of the developed principles to the identified features of the EFQM model and its criteria (Nabi, 2013[c]) (**Table 2**).

Table 2. Compliance of the developed principles to the identified features of the EFQM model and its criteria

EFQM model features	Specific principles of design of a higher education quality assurance system	EFQM model criteria
Makes it so both the leaders of the organization and all personnel have to have "qualitative culture"	Focus on the top officials of the organizations that use the designed project	Leadership
	Regard for the psychological aspects of the design and operation of the designed object	1) Employees (personnel); 2) Employee related results
Allows assessing the achieved results and using them to find ways to coming closer to becoming a perfect (ideal) company	Workability principle	1) Processes; 2) "Results" group; 3) Partnerships and resources
	Openness principle	
	Correlation of managerial actions and internal self-organization trends in a developing system	
Aimed at determining areas for improvement	Workability principle	1) Politics and strategy; 2) Processes
	Modularity principle	
	Regard for multiple ways for developing the system	
Allows expressing the results of activity quantitatively (in points)	Ability to control and monitor processes	Key results

In previously published studies (Nabi, 2014b; Nabi, 2013d) that focus on the results of theoretical and methodological investigations, the authors developed a design technology for a higher education quality assurance system based on the EFQM model (Nabi, 2014c). The substantiation of the design stages was a difficult task. In literature, the opinions on this matter differ widely: from two (for instance, study (Nabi, & Shaprova, 2010)) to 15 stages (for instance, study (Nabi, Tokmagambetov, & Ibishev, 2012), while paper (8 Stages Of Design & Construction) offers eight stages – from the "Initial Contact" to the "Maintenance Stage".

We substantiated three design stages, which is why the design technology was also divided into three stages:

- preliminary preparation, which consisted in the realization of the practical block in the developed models (models of the quality management subsystem, inherent quality assurance subsystem, and quality confirmation subsystem);
- engineering design – work based on analytical notes on the execution of the first stage in accordance with the "operation" parameters of the developed models with regard to the fact that in the models, said parameters corresponded to the RADAR index matrix from the EFQM model;
- detailed design, which consisted in the development of detailed documentation: provisions, plans, flowcharts, estimations, innovative educational technologies, methods, etc.

The main component of this technology are process sheets for each subsystem. The first column of each sheet lists the design stages that were rationalized above; following columns list the tasks of each stage, the nature of activity of each design subject, and the result that was achieved after completing the task, which is prepared by trained designers.

Results of Experimental Work

As noted above, measurement materials (questionnaires and tests) and assessment criteria that were systematized in scoresheets were developed for the collections of data for the assessment of the quality of each object. Obtained data were treated using specially developed electronic tables.

Experimental work on the implementation of the design technology for a higher education quality assurance system based on the EFQM model was done at the Kazakh Leading Academy of Architecture and Civil Engineering (KAZGASA), the Kazakh-American University (KAU), and the S. Seifullin Kazakh Agrotechnical University (KATU).

In accordance with the described methods, the general conclusion regarding the formation of learning motivation was based on the analysis of the interconnection between the general attitude to learning and the formation of learning motivation. High level of general attitude to learning and prevalence of cognitive motives of learning corresponded to the high level. Moderate level of general attitude to learning and prevalence of social motives of learning corresponded to the moderate level. Low level of general attitude to learning and prevalence of social motives of learning corresponded to the low level (the overall prevailing motive is "avoidance of trouble").

An employer survey was carried out to determine the requirements set by employers to graduates and to investigate the image of graduates of said higher educational institutions on the labor market. The treatment of answers to the question: "Which professional knowledge and personal qualities, in your opinion, do the graduates that come to your company lack?" showed that the graduates of the three higher educational institutions were

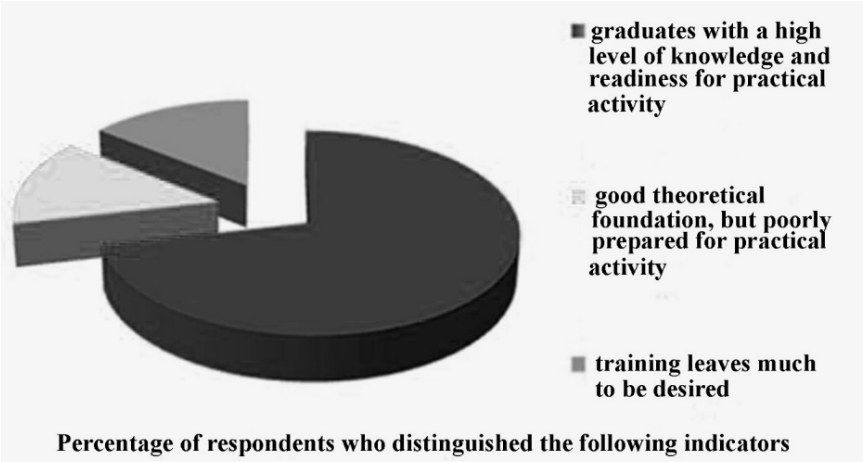

Figure 3. Illustration of the image of S. Seifullin Kazakh Agrotechnical University graduates

insufficiently prepared for practical activity, lacked independence and initiative (this concerns the graduates of the Kazakh Leading Academy of Architecture and Civil Engineering), understanding of the actual demands of the market (this concerns the graduates of the Kazakh-American University), and theoretical knowledge (this concerns the graduates of the S. Seifullin Kazakh Agrotechnical University).

When answering the question "What, in your opinion, is the image of graduates on the labor market?", most respondents identified them as "graduates with a high level of knowledge and readiness for practical activity" (**Figure 3** shows an example).

Since the method for assessing personnel that was used in this study is more suitable for assessing company personnel, the significance factors of questionnaire indicator had to be recalculated to assess the quality of personnel via group expert assessment. The experts determined the specific gravity (significance) of attributes of professional and personal qualities as follows (**Table 3**):

Table 3. Adjusted specific gravity of attributes of professional and personal qualities in teachers

Attributes of professional and personal qualities	Specific gravity
professional competency – in-depth knowledge in a special field, pedagogical mastery	0.226
recognition of responsibility for the quality of students' independent work and academic achievements	0.164
ability to organize and plan activity in a clear manner	0.165
ability to perform one's functions independently	0.169
activity and initiative in learning new computer and information technologies	0.163
ability to maintain a high working ability in extreme conditions	0.115

The investigation of personnel quality by the example of several departments showed that a significant part of the academic staff were professionally competent – they had in-depth knowledge in a special field and pedagogical mastery (74.4% of teachers had above-average or average indices). The problem lies in activity and initiative in learning new computer and information technologies, the average index whereof is lower than other indices. A profile of each teacher's professional and personal qualities was built based on obtained data with regard to the data from **Table 3**. **Figure 4** shows an example of a profile of an MOV teacher with the highest indices.

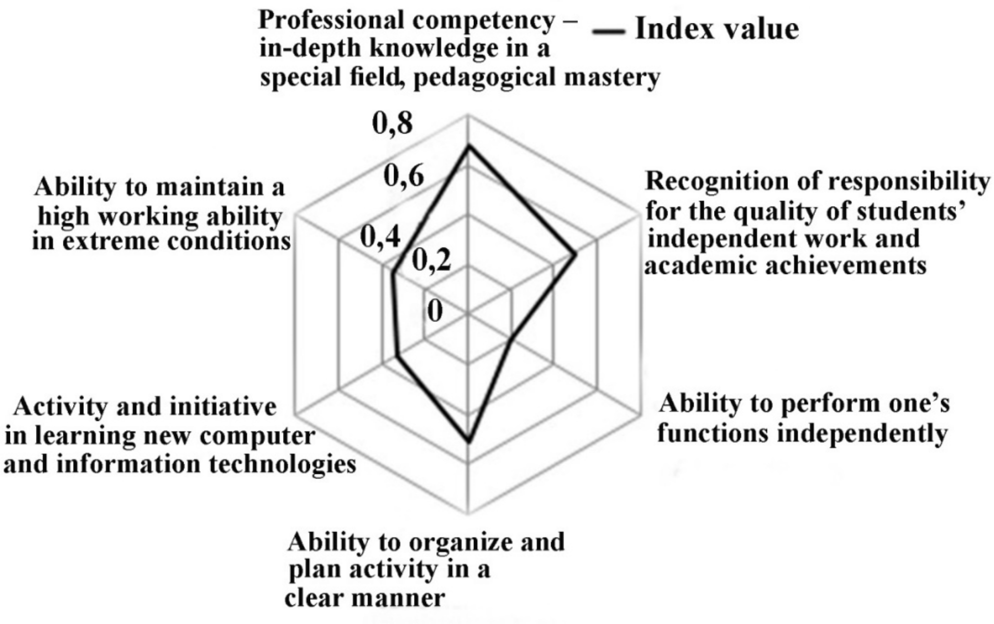

Figure 4. Profile of an MOV teacher

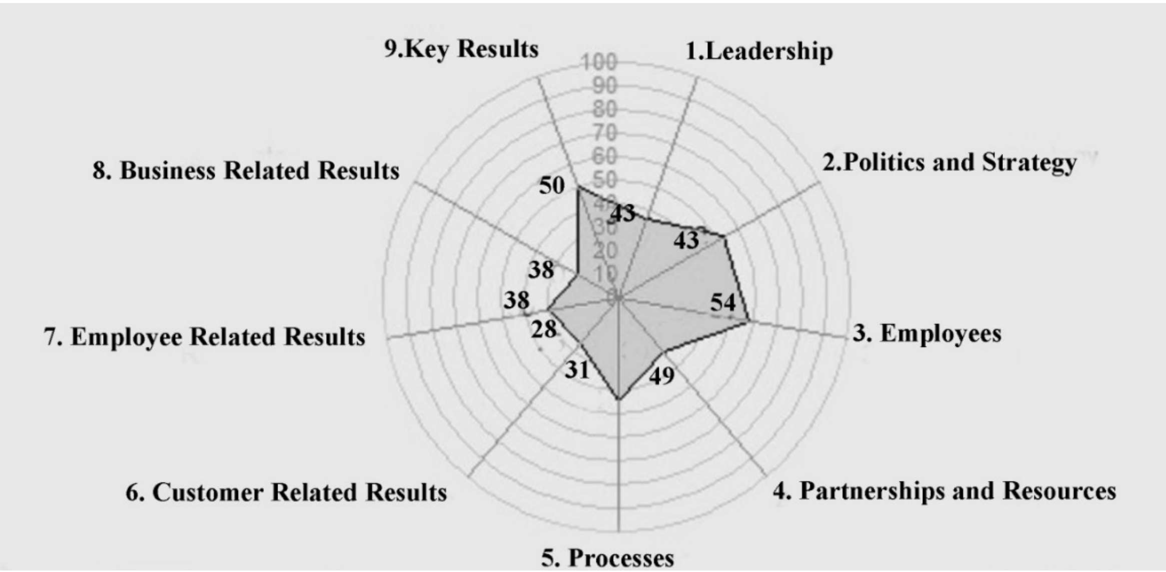

Figure 5. Results of activity of the S. Seifullin Kazakh Agrotechnical University

Investigation of the quality of educational facilities at the teachers' disposal showed that it was assessed at 3.43 points out of 5 on average. The survey included 97 teachers, according to whom, the greatest weakness of educational facilities was the educational equipment.

The results of customer related, employee related, and business related activities and key results of higher educational institutions were prepared using special software and presented in the form of a diagram (**Figure 5**).

The analysis of the quality of the educational technology showed that only 50.8% of teachers consolidated and tested knowledge in practice in simulation forms (planned games, roleplay); teachers did not plan or prepare parts of classes with students (**Table 4**).

Table 4. Results of analysis of the quality of the educational technology

Criteria that are indicative of a good planning of classes	Percentage of students that noted the presence of the criterion
1) Class plans are in line with the goals of the discipline and occupational training.	71.9
2) Goals and requirements (criteria of successfulness) of classes are clearly formulated.	74.4
3) Learning forms often change.	47.9
4) Sufficient time is devoted to questions and discussions.	71.5
5) Learning of facts comes after the understanding of higher principles and regularities.	61.8
6) Knowledge is consolidated and tested in practice in simulation forms (planned games, roleplay).	50.8
7) Students' needs are taken into consideration in the academic goals of classes.	65.3
8) Students are treated as partners that bear responsibility for learning and understanding.	70.1
9) Students are actively involved in the planning and realization of classes.	53.2
10) Parts of classes are prepared and formed by students (together with the teacher).	2.78
11) Planning facilitates active forms of learning and reciprocal learning of students.	64.3
12) Supplementary learning materials, textbooks, and visual aids are professionally orientated.	69.5

DISCUSSION

In order to assess the obtained results in terms of goal achievement, it is necessary to find out if the developed technology matches the set validity criteria.

As was shown above, the model of design of the higher education quality assurance system has a modular structure and is qualimetric and diagnostic. Assessment is an integral part of any quality assurance system, since in order to manage any process it is first necessary to be able to measure its parameters. Without quantitative assessments of quality, it is impossible to study the informational aspects of the product quality problem. Based on the above, it is stressed that the design technology for a higher education quality assurance system based on the EFQM model meets the criteria of construct validity. It is worth noting that probability-based design is used for such systems, since the two theorems regarding the incompleteness and consistency of formal systems, proven by K. Gödel (2010) and the principle of uncertainty of humanities systems, formulated by M. Archer (2013) allow concluding that the uncertainty will be significant in the design of social, including educational, systems.

We built a matrix of functions, criteria, and indices of higher education quality used in the European educational space, in which each function of the higher education quality assurance system used in the European educational space correlated with certain criteria and indices. This correlation was discovered for the first time in Kazakh pedagogical science. At the same time, this matrix has its flaws: the functions, criteria, and indices of the quality assurance systems are presented incompletely, some phrasings of indices are vague. However, the latter is not the fault of the authors, but rather of the creators of standards that this study was based on. Fortunately, this circumstance is taken into account in EURASHE, which reviewed the Standards and guidelines for quality assurance in the European Higher Education Area (ESG) with the involvement of a wide range of experts, with a view to making changes.

In the developed design technology for a higher education quality assurance system based on the EFQM model, each preliminary stage is intended to achieve its specific goal in a way that would give a real opportunity to proceed to the completion of tasks of the following stage; at that, the results of each stage are documented, thus extending and enhancing the results of the previous stage. The final results of the work are largely determined by the interconnection of results obtained at individual stages of the work. Hence, the technology provides criterion validity.

The content validity is confirmed using the data of experimental work. Examples for all indices are presented below. In addition, **Figure 6** shows the results of the activity of the S. Seifullin Kazakh Agrotechnical University.

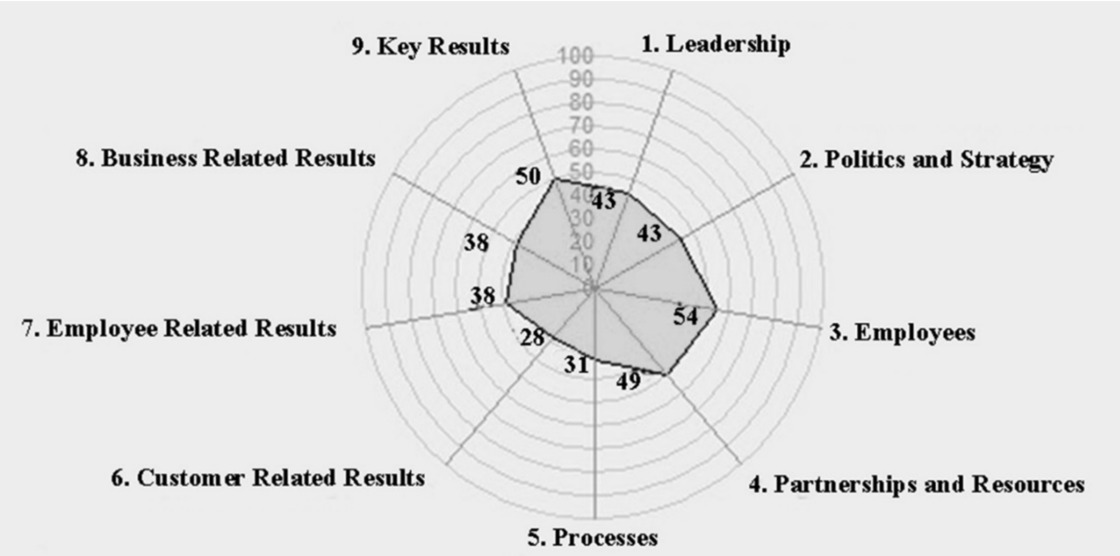

Figure 6. Results of the activity of the S. Seifullin Kazakh Agrotechnical University

When comparing this diagram to the one presented in **Figure 5**, one can see no significant differences between the indices of the two higher educational institutions. The trend of low "Customer Related Results", "Employee Related Results", and "Business Related Results" is noted. This trend is related to the fact that Kazakhstan does not pay enough attention to the integration of higher educational institutions and business, while the low customer and employee related results are caused not by the fact that higher educational institutions do not realize the importance of this category, but by the fact that the data were obtained from institution accreditation reports, which were prepared by Kazakh accreditation agencies, the standards whereof, unlike the EFQM model, lack these indices. The EFQM model assesses the *presence of evidence* for each component according to standards:

- no evidence or random evidence – 0
- some evidence – 25%
- evidence – 50%
- obvious evidence – 75%
- exhaustive evidence – 100%.

Table 5 presents a comparison of the main indices of experimental work among the three higher educational institutions.

The level of the learning motive in the Table was separated from the social, position, assessment, and game motives, considering the importance of cognitive motives. The quality of personnel was also shown via the most important criteria and mean data. The quality of the educational technology was shown via the largest and smallest data, as well as by mean data.

The presented data show that the results are mostly similar, with only the level of learning motives among Kazakh Leading Academy of Architecture and Civil Engineering students being higher than that of students of other higher educational institutions. This is caused by the fact that agrarian specialties are not in demand; they are usually enrolled into by poorly trained enrollees; the Kazakh-American University is a private university, which is why its status also affects the image of the higher educational institution. The presence of the "approximately identical level of designers" parameter is confirmed by the fact that each group that realized the project had managers of structural units – experienced teachers. The level of skills of experts that were involved in obtaining raw data was identical: 95% of experts had PhD and Sc.D. degrees.

To sum up, quality in higher education is regarded as not a uni-dimensional concept and is in fact best described as a set of dimensions. Thus, V. Teeroovengadum, T. Kamalanabhan & A. Seebaluck (2016) believe it is relevant to adopt the dimensions of the SERVQUAL model, which proposes five dimensions, namely, responsiveness, assurance, tangibles, empathy and reliability. An important problem to be solved is that most models including the SERVQUAL model take into account only the element of functional quality and neglect the technical quality aspect, including the case in the higher education context (Kang, 2006).

Table 5. Main indices of the experimental work, compared across the three higher educational institutions

Indices		KAU	KAZGASA	KATU
Percentage of students with a high level of learning motive		10.0	17.68	11.66
Problems in specialist training (percentage of employers that noted this index)	Lack of basic theoretical knowledge	33.3	10	29
	Poor readiness for practical activity	66.7	50	29
	Poor understanding of the actual needs of the company and the labor market	33.3	10	21
Graduate characteristic (percentage of employers that noted this index)	Graduates with a high level and readiness for practical activity	0	30	14.1
	Good theoretical basis, but insufficient readiness for practical activity	66.7	50	70.5
Personnel quality (points out of the maximum 3)	Professional competency	2.7	2.7	2.6
	Recognition of responsibility for the quality of students' independent work and academic achievements	2.1	2.0	1.7
	Mean index	1.93	2.15	1.83
Quality of educational facilities (points out of the maximum 5)		2.97	3.33	4.0
Educational technology quality (percentage of students that noted this criterion)	Class plans are in line with the goals of the discipline and occupational training	86.0	85.6	76.5
	Parts of classes are prepared and formed by students (together with the teacher)	0	6.0	2.35
	Mean data	69.36	62.9	65.9

CONCLUSIONS

The analysis of the prospects for the development of education in the Republic of Kazakhstan allowed concluding that in conditions of autonomy, higher educational institutions should adjust their quality assurance mechanisms and switch from the coercion model to the improvement model – the EFQM model.

The developed theoretical and methodological framework of system design enabled rationalizing the design technology. Its implementation implied a close interaction between developers and designers and the presence of a clear method for collecting empirical data. Before the technology could be recommended for use in the practice of higher educational institutions, its validity had to be confirmed.

This confirmation resulted from the completion of the following tasks: determine the validity criteria for the developed technology; show that the developed technology met the validity criteria.

The completion of these tasks determines the novelty of this study, since, for the first time in Kazakhstan, not only design technology for a higher education quality assurance system was developed, but also the possibility of its realization was proven.

This predetermines the practical significance of the study: higher educational institutions can use its results independently to design a higher education quality assurance system based on the EFQM model or develop their own technologies with regard to the peculiarities of the institution.

Another important result of this study is that it distinguished three directions, in which the validity of a technology should be confirmed. At that, it produced a theoretical result: it substantiated the criterion that is applicable to technological processes in a pedagogical system. This determines this study's contribution to the theory of pedagogical validation.

Thus, based on the above, the conclusion is that the construct, criterion, and content validity of the design technology for a higher education quality assurance system based on the EFQM model was confirmed, i.e. the goal of the study was achieved.

It is pertinent to point out that this research can be regarded as basis for further investigations on higher education quality assurance. Thus, it is possible to compare the results obtained after the implementation of the described system both in technical and humanitarian universities. Moreover, it would be interesting to describe the features of ISO 9001:2001 model in developing countries and countries with the highest level of state social protection and development.

ABBREVIATIONS

ISO – International Organization for Standardization

EFQM - European Foundation for Quality Management

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