

Design and Implementation of a Quality Management System for Electronic Training Information Resources

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Abstract: the results on designing and implementation of quality management system of electronic learning resources and its use for the organization and carrying out of monitoring of quality of resources of a higher educational institution are presented. As the illustration of quality monitoring of resources in KSU is used the distance learning system «Kherson Virtual University».

Keywords: quality management system, monitoring and quality management of learning electronic resources, distance learning system «Kherson Virtual University».

1 Introduction

Maintenance of quality of training is one of the primary goals of a university education system. The concept «quality of education» has no standard definition. It is connected by that various groups of consumers put in it their sense and researchers treat it depending on the research problem. Thus it is possible to allocate two basic approaches to concept of quality:

- In the first case for a basis of quality of education the requirement of conformity to the standard is accepted
- In the second case for a basis of quality of education the satisfaction to requirements and expectations of consumers is accepted

Therefore at the analysis of quality of education in university it is necessary to consider two aspects: conformity to standards and satisfaction to requirements of consumers which are students and the university faculty.

One of the major problems of the higher school are the organization of the monitoring system of quality of education and maintenance of constant growth or maintenance at high level of indicators of quality of education. It can be reached by introduction of a control system of quality of educational process and quality of educational services with use of information-communication technologies. In particular quality management of such new forms of training, as distance learning has the important importance. One of objects of the analysis of quality of educational process are electronic information resources (EIR), providing educational process. In particular, distance learning courses are one of the major and most often used EIR [1].

Since EIR are classified as educational electronic editions and are software

products then monitoring of quality of electronic educational resources should be multilevel taking into account their classification signs. Classification principles allow considering the separate characteristics of electronic means of educational purpose for carrying out of monitoring of EIR quality as a whole. Criterion of quality degree of EIR compatibility with standards IMS, SCORM can be chosen.

In work [2] the results of the analysis of criteria of quality and designing of monitoring system of EIR quality in distance learning system (DLS) «Kherson Virtual University», developed in the Kherson State University (KSU) are presented.

2 Structure and architecture of a control system of EIR quality

The EIR quality management system (QMS) is a structural element of architecture of a control system of quality of education in a higher educational institution.

In university taking into account a control system of EIR quality it is possible to present the general scheme of quality management of education as follows (Fig. 1):

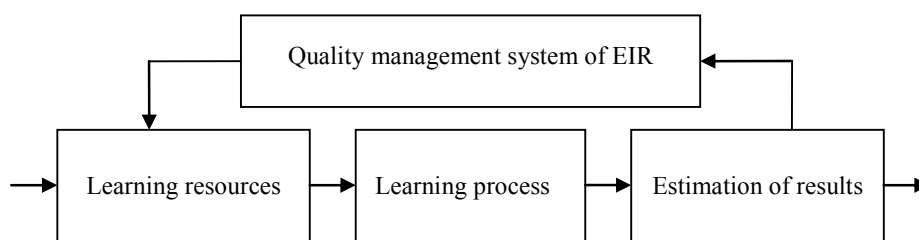


Fig. 1. The quality management system of EIR in architecture of quality management of university education

Thus, EIR QMS plays a role of feedback in the course of training for the purpose of EIR quality assurance and resource maintenance of process of training. Therefore constant functioning EIR QMS taking into account the correct organization of its work should provide high level of EIR quality indicators. On the other hand this system carries out a problem of rejection poor-quality learning EIR, defining their life cycle.

Itself EIR QMS represents the difficult system consisting of objects which carry out the analysis, research and management in the parameters providing EIR quality in the learning course.

The structure of a control system is presented by EIR quality in Fig. 2.

According to the resulted structure EIR QMS managerial process by quality of electronic learning resources consists of a complex of the following interconnected actions. Carrying out of monitoring of EIR quality is a quality assurance major factor, defining, first of all, degree of EIR conformity to educational standards. The important criterion of an estimation of EIR quality is degree of satisfaction of users of these resources of training. The university advisory council supervises over work on carrying out of monitoring of EIR quality and the analysis of results of questioning of students and teachers under program Feedback, defining Estimation criteria of EIR.

Certification of EIR under standard ISO 9000/9001 can serve as an estimation of high quality. At the same time, requirements and recommendations of these standards can serve as criteria of an estimation of EIR quality. The estimation of EIR quality is the tool of improvement of consumer characteristics of these resources, defining directions of researches at support and working out (acquisition) of new electronic resources of training. Acquaintance of the faculty of university with EIR rating promotes increase of motivation of teachers to use of qualitative resources and mastering by new information technologies of training.

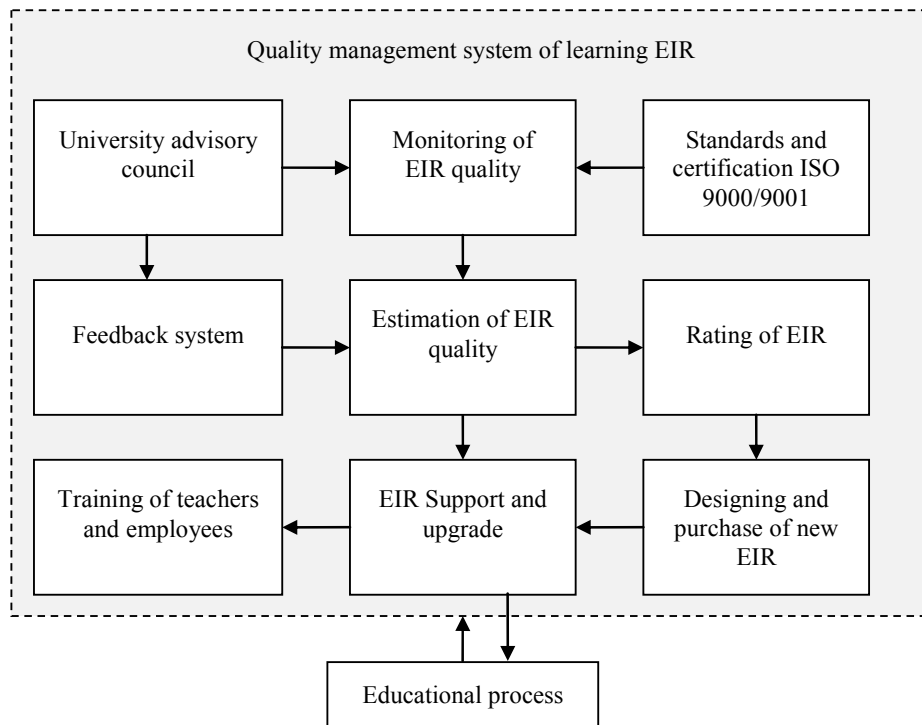


Fig. 2. Structure of a control system of EIR quality.

The control system of EIR quality should contain list of supervising documents, actions and an order of their realization which are reduced to the following in university:

- Administration problems (a policy in the field of quality, the work organization on its embodiment)
- Documentation and planning system
- Quality during working out of plans and programs (competence of developers, level of prepared documents, performance check, a timely estimation of results, entering of necessary changes)
- Quality assurance got EIR training
- Quality at a stage of EIR manufacture (introduction the QMS of working out new EIR)

- Quality check used EIR (entrance checks, the interoperational control, the definitive control, the documentation of tests)
- The control over test means
- Careful research of defective educational resources, detailed finding-out of the reasons of occurrence of defects, carrying out of correcting actions
- Quality of EIR storage, protection against harmful programs
- Documenting of EIR quality, registration of necessary documents
- The analysis of quality and acceptance of corresponding measures
- Personnel training

Let's stop in more details on basic elements of control system of quality of electronic training resources.

2.1 Estimation of EIR quality

The estimation of EIR quality underlies a control system of quality of electronic resources of training. For an estimation of EIR quality it is necessary:

- On a constant basis to carry out monitoring of EIR quality for control of EIR quality
- To have a feedback with users of EIR for the account of wishes in their improvement from positions methodical and program-technology requirements

For carrying out of monitoring of EIR quality it is necessary to develop their criteria of quality. The university advisory council confirms the criteria of EIR quality developed by the methodical commissions. The university Advisory council also confirms recommendations about improvement qualities of EIR received as a result of the analysis of responses of users in Feedback system.

Results of an estimation of EIR quality should be used on the one hand for improvement of their substantial part and satisfaction to technology requirements, on the other hand for publication of a rating of electronic learning resources that also promotes increase of their quality.

2.2 Monitoring of EIR quality

Monitoring of EIR quality possesses a leading role at their estimation of quality. The analysis of electronic resources of training shows, that they have the following classification: to a functional sign they can be carried to training editions, under the form of representation they belong to a category of electronic editions, on technology of creation they represent software product [1]. Therefore monitoring of quality of electronic educational resources should be multilevel taking into account their classification. The satisfaction requirement to the standard international standards what are IMS, SCORM [2] is uniting attribute of multilevel monitoring of EIR quality.

2.2.1 Monitoring of EIR quality to a functional sign

Now for university which includes four groups of the educational information resources differentiated to a functional sign, defining their value and a place the certain typological model of system of educational editions has affirmed as educational process [2]:

- Learning-methodical (methodical instructions, the managements containing materials by a technique of teaching of a subject matter, course studying, to performance of course and degree works)
- Training (textbooks, manuals, texts of lectures, abstracts of lectures)
- Auxiliary (practical works, collections of problems and exercises, reading books)
- Supervising (testing programs, databases)

2.2.2 Monitoring of EIR quality by criterion of compatibility with educational standards

IMS specifications are information model of the description of educational objects. It defines the standardized set of information blocks which are contained by data about an educational resource. The IMS-package which contains educational object consists of two main elements [2]:

- The IMS-manifesto – a special file which describes base resources, the maintenance and the organization of educational object (it is represented in language XML)
- Physical files which make educational object

The similar organization of resources corresponds to modern approaches to work with electronic educational resources, in particular, to the concept of educational object.

The IMS-manifesto is base concept of specification IMS. Conceptually the IMS-manifesto is the multilevel description of data. At the lowermost level there is a description of physical files which form an educational resource. Some descriptive information named metadata which also joins in the manifesto can respond each file.

2.2.3 Types of EIR

Four groups of the educational information resources differentiated to a functional sign which defines their value and a place in educational process are distinguish [2]:

- Program-methodical (curricula and working programs)
- Learning-methodical (the methodical instructions containing materials by a technique of teaching of a subject matter, course studying, to performance of course and degree works)
- Training (textbooks, manuals, texts of lectures, abstracts of lectures)
- Auxiliary (practical works, collections of problems and exercises, encyclopedias, reading books)
- Supervising (testing programs, databases)

Each group of EIR has the distinctive features and the parameters defining quality of this or that educational information resource. So most often educational EIR the electronic textbook (course of lectures) which concerns training resources is used. Among the parameters defining quality of the electronic textbook it is possible to allocate in particular completeness of representation and coherence of training

information materials, presence of the control-help information, conformity to the maintenance of the working program, organization and sequence of a material, ergonomics of the text, presentation of a material: use of multimedia possibilities, interactive systems and modules, modeling possibility, and also testing use, possibility of monitoring of knowledge, self-checking have text formatting, use of tables, schemes, drawings, illustrations, etc. has special importance.

Completeness of the electronic textbook assumes presence of following additional information resources:

- The textbook title page
- The summary it (is desirable)
- The course program
- The list of reductions (if it is available)
- The list of illustrations
- Data on the author
- Actually texts that (heads) № 1, 2, 3, ...
- The list of the recommended literature on subjects
- The list of the quoted literature in the end of a course
- Applications (the list of statutory acts, decrees, decisions if they are available)

Along with the electronic textbook the important role is played by a control-help part of resource maintenance of a course which should contain:

- The list of questions and tasks for self-examination studied to each subject-head, section and to all course (or the list of questions and tasks for computer training in the environment of multimedia)
- Subjects of course works and abstracts
- The approximate list of examination questions at all course (or to offset)
- The chronological index (if it is available)
- The index of names (if it is available)
- The index (if it is available)
- The dictionary of terms
- Methodical instructions (or recommendations)

Among all EIR the special role is played by a distance learning courses. It is the basic educational object which is used in distance learning. Its feature consists that it is compound training object which unites various EIR for the purpose of the organization of process of training with use of special program environments – DLS. An example of such program environment which allows to create, keep and use distance courses, is DLS «Kherson Virtual University» [2].

Thus, EIR should be differentiated depending on their type. First of all, it concerns expenditures of working hours on creation of these resources, both time, and intellectual. Therefore at an estimation of concrete EIR quality it is necessary to start with some generalized criterion of working hours input of its creation which can be expressed in weight factor:

- A course of lectures
- The plan-abstract to a course of lectures, laboratory and practical works
- Methodical instructions to carrying out of seminar employment and performance of laboratory works
- The test

- The working program of a course
- Questions to examination/offset, self-checking
- A laboratory practical work
- The collection of problems, exercises, the dictionary
- The methodical grant
- The encyclopedia
- Distance learning course on discipline

It is necessary to notice, that depending on type educational information resources have as the general, and the distinctive criteria of quality which are expressed by quality indicators:

- Completeness of methodical maintenance of discipline
- Authorship of a material
- Completeness of representation of a material
- Conformity to the maintenance of the working program
- Sequence of materials
- Conformity of a material to the world standards
- Degree of use of a resource
- Material organization
- Ergonomics of the text
- Use of links
- Presentation of a material
- Use of multimedia modules
- Use of interactive systems and modules, modeling possibility
- Testing use, possibility of monitoring of knowledge, self-checking
- Use of standard formats of EIR files
- Use of tables, schemes, drawings
- Conformity of a material to level of knowledge of users
- A special-purpose designation of a material for a corresponding audience
- An easy approach to a material
- Stylistic correctness of a statement of a material

Among the basic types of the software for creation e-Learning decisions it is possible to allocate Authoring Packages, Learning Management Systems (LMS), Content Management Systems (CMS), Learning Content Management Systems (LCMS).

Author's products are specially developed for overcoming of those difficulties which teachers face at use of programming languages. These programs usually allow the teacher to develop independently an educational content on the basis of visual programming. A lack of such products is the impossibility to trace and supervise in time process of training and progress of a considerable quantity of trainees. As a rule, they are developed for creation of lessons with an immediate feedback with the trainee, instead of for storage of the information on educational process for long time.

LMS (in Russian-speaking terminology abbreviation DLS is used – "distance learning system") represent a platform for expansion e-Learning, but in some cases can be used and for administration of traditional educational process.

System LMS, in an ideal, should give to each student personal possibilities for the most effective studying of a material, and to the manager of educational process - necessary tools for formation of curriculums, the control of their passage, drawing up of reports on productivity of training, the organization of communications between students and teachers. The student receives from LMS access possibilities to an educational portal which is a starting point for delivery of all educational content, a choice of suitable educational tracks on the basis of preliminary and intermediate testing, use of additional materials by means of special links.

2.2.4 Criteria of EIR quality

The system of monitoring of EIR quality can be based on multicriterion analysis of conformity of these resources to the standard educational standards.

Classification principles allow considering separate characteristics of electronic means of educational appointment for carrying out of monitoring of EIR quality as a whole. Criterion of EIR quality compatibility with standards IMS, SCORM [2, 3] can be chosen.

Let's pass to construction of the general criterion of EIR quality. For a basis of a conclusion of criterion of quality we will accept the standard approach based on consideration of the average factor of quality $K = (a_1k_1 + a_2k_2 + \dots + a_nk_n)/n$, where a_i – average value of indicators of quality, k_i – value of weight factor of i -type resource [4].

The general criterion of EIR quality can be calculated under the formula

$$K_0 = \sum_{i=1}^N a_i t_i . \quad (1)$$

where $a_i = n_i \cdot \gamma_i$ – the quality metrics, n_i – weight factor, $\gamma_i = \sum_{j=1}^{m_i} k_{ij} / k_{iM}$ – average factor of quality, m_i – quantity of metric indicators of quality, k_{ij} – a quality j -indicator, k_{iM} – the greatest possible value of an indicator of quality, t_i – the generalized factor of quality of i -type resource, N – quantity of EIR.

For definition of ratings of faculties and chairs of a higher educational institution it is necessary to enter into consideration relative average criterion of quality $K = K_0 / N$, where K_0 is calculated under the formula (1).

2.3 Feedback system

Demand studying on EIR, as well as on any other intellectual product, is necessary for revealing of their qualities on purpose improvement of their methodical and program-technological properties. The Feedback system with users of EIR serves as the tool for the organization of flexible and all-round interrogations of opinions of students and teachers of university. Usually the system spends questioning in an automatic mode. The built in master of interrogations allows to create easily and simply interrogations, to make to them changes and to spend questioning sessions. The generalized estimation of EIR quality received after statistical processing of results of questioning of users, gives the chance to consider degree of their demand at quality monitoring.

There are specialized systems “Customer Feedback” which help to organize process of questioning of EIR users. Besides data gathering, these systems offer powerful tools of the analysis and the reporting. At the Kherson State University there is an automated feedback system “KSU Feedback” (<http://feedback.ksu.ks.ua>) which is used for gathering of the information from users of EIR about quality of training, in particular about qualitative characteristics of electronic resources of training.

2.4 Standards and certification ISO 9000/9001

Certification is a documentary acknowledgement of conformity of production to certain requirements, concrete standards or specifications. It is necessary to notice, that conformity to standard ISO 9000/9001 does not guarantee high EIR quality. However conformity to requirements and recommendations of these standards is a necessary condition of high quality of resources of training. The certificate of conformity ISO 9001 is acknowledgement of satisfaction to standard requirements.

Standard ISO 9000/9001 is fundamental, the terms accepted in it and definitions are used in all standards of a series 9000. This standard pawns a basis for understanding of base elements of system of a quality management agrees standards ISO.

Requirements of standard ISO 9000/9001 can be used as criteria at the organization and carrying out of monitoring of EIR quality.

2.5 Advisory council of university

In a control system of EIR quality the university advisory council is the body which is responsible for adequacy estimation of EIR quality taking into account all criteria and indicators of quality. It confirms Position about a control system of EIR quality, defines criteria of their quality, forms rules of carrying out and confirms results of an estimation of quality, and also plans actions for improvement of EIR quality.

The university advisory council defines an order of carrying out of monitoring of EIR quality. It confirms the list of criteria of quality, their weight factors and values of indicators of quality according to (1).

2.6 Support and upgrade of EIR

Support and upgrade of EIR is the important site of work in a control system of quality in respect of elimination of defects, improvement and EIR software at its use in educational process. Support of EIR software is one of phases of life cycle of the software in which course in EIR software changes for the purpose of correction of the lacks found out in the course of use are made, and also for addition of new functionality and efficiency increase. Support software is defined by standard IEEE Standard for Software Maintenance (IEEE 1219), and the life cycle standard is specified ISO 12207.

Support of EIR software is necessary for that maintenance that the software product throughout all period of operation meets requirements of users. Tracing and

the control – key elements of activity on support of EIR software.

The important factor of increase of efficiency usage of EIR is training of users and maintenance with their regular support at work with the current software version.

Support and upgrade of EIR software should consider also updating of capacity of the hardware or a corresponding telecommunication infrastructure.

3 Control system of EIR quality at the Kherson State University

The control system of EIR quality at the Kherson State University works since 2009. It includes all actions and activity of services according to described above the scheme of structure of EIR quality management (fig. 2).

The system of monitoring of EIR quality in DLS «Kherson Virtual University» is based on the multicriterion analysis of conformity of these resources to the conventional educational standards [2]. All resources of electronic library were estimated by criterion K_0 according to (1) with values of weight factors and the indicators of quality confirmed by expert methodical commission of Kherson State University.

Monitoring of EIR quality in distance learning system «Kherson Virtual University» is spent according to the order of rector of university and sets as the purpose, first, to give quality standard rather to great volume of training resources (more than 5000 names), developed by teachers of university, and, secondly, to plan ways of quality improvement of work of faculty KSU to this direction.

4 Conclusions

The system of monitoring of EIR quality can be based on the multicriterion analysis of conformity of these resources to the standard educational standards.

Classification principles allow considering separate characteristics of electronic means of educational appointment for carrying out of monitoring of EIR quality as a whole. Criterion of EIR quality compatibility with standards IMS, SCORM can be chosen.

It is possible to use and other criteria of classification, however, without dependence from appointment, a technique of use or technology of realization, a basis of any didactic means is the teaching material of a studied subject domain. Selection of this material (which it is carried out proceeding from didactic problems and methodical principles) is a prerogative of the teacher. For this reason the computer (distance) course should be the integral multicomponent system reflecting scientific and methodical sights of the author. The corresponding commission of experts of university should give an estimation of quality of distance learning course.

On a basis of multi-criteria analysis taking into account EIR compatibility with the international standards criteria of EIR quality are described.

The basic types of electronic resources of educational appointment for carrying out of monitoring of EIR quality are allocated. For each type of EIR their weight factors and quality indicators are offered. The criterion of quality of an electronic training

resource which is the average characteristic of quality is developed, considers its weight factor and relative indicators of quality.

The offered system of an estimation of quality of electronic training resources is not unique and supposes additions and updating. The estimation of monitoring of EIR quality is given by a corresponding commission of experts of university.

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