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Measuring of Quality in the Context of e-Learning

Martin Misut^{a*}, Katarina Pribilova^b

^aDepartment of Applied Informatics, Faculty of Economic Informatics, University of Economics in Bratislava, Dolnozemska cesta 1/b, 852 35 Bratislava, Slovakia

^bDepartment of Mathematics and Informatics, Faculty of Education, Trnava University, Priemyselna 4, 91843 Trnava, Slovakia

Abstract

For the purpose of clarity and consistency, the term e-learning is used throughout the paper to refer to technology-enhanced learning. This paper describes selected aspects of the implementation model, which aims at the improvement and complex assurance of quality and cost efficiency in the context of e-learning. Within the described project, a complex quality assurance method, based on a model for quality assessment of e-learning – ELQ, has been proposed and verified. A modified Kirkpatrick Evaluating Four Level Model has been used for evaluation of quality of blended learning. After implementation of described models, experimental data has been collected and analyzed. These will drive the direction for future improvements.

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1. Introduction

The quality of education is a widely used phrase at present. The quality can be seen differently in conjunction with the knowledge, information and educational technologies. These can be considered as catalyst for change in education, where the goal of our efforts is reforming and modernizing education for our knowledge-based society. One part of the effort is devoted to the special issues of quality of e-learning, which is seen as a potential tool for changes in education. Not only a number of studies (e.g. (Agariya & Singh, 2012; Al-Mushasha & Nassuora, 2012; Bremer, 2012; Ceobanu & Asandului, 2009; Clements & Pawlowski, 2012; Dobre, 2012; Gamalel-Din, 2010;

* Martin Misut. Tel.: +421- 2 6729 5859; fax: + 421-2 -6729 5182
E-mail address: martin.misut@euba.sk

Cheung & Vogel, 2013; Iqbal & Ahmad, 2010; M. Z. Iqbal, Maharvi, Malik, & Khan, 2011; Islam, 2013; Jayakumar, Manimaran, & GopiAnand, 2013; Jung, 2012; Lai & Sanusi, 2013; Liu, Huang, & Lin, 2012; Marshall, 2012; Masoumi & Lindström, 2012; Meier, Seufert, & Euler, 2012; Ossiannilsson & Landgren, 2012; Ramakrisnan, Yahya, Hasrol, & Aziz, 2012; Saatz & Kienle, 2013; Tamrakar & Mehta, 2011; Teodora, Mioara, & Magdalena, 2013; Voogt, Knezek, Cox, Knezek, & Brummelhuis, 2013; Zhang & Cheng, 2012) have been published, but various interest groups and commercial institutions dealing with these issues rose recently, one of them being the European Foundation for Quality in eLearning (EFQUEL). Its declared aim is to share experiences on the use of e-learning, to enhance individual, organizational, local and regional development, digital skills and promote social cohesion and personal development. (more at <http://efquel.org>)

Education is one of the two basic functions of the University. A big pressure to rationalize public educational institutions exists currently in Slovakia, while as a survival factor was defined in the quality of them. Quality criterion for science and research is widely accepted and has a quantifiable expression; the situation is more complicated for the quality of education. For a comprehensive assessment of the quality of an educational institution, it is necessary to formalize also this aspect of its activities. The quality of educational activity from the perspective of future is crucial to the creation of a suitable environment providing the necessary educational services to students in terms of content, availability, speed, flexibility, timeliness and the like, so that not only process, but also outcomes reflect the quality standards. Lack of generally accepted quantifiers of quality, as well as strong state pressure on results of science, create a space for the innovation in education and specifically the development and subsequent broad implementation of such a education model, which substantially contribute to enhancing the quality of the institution. The measurement (quantification) of the quality of education is the key element in improving the quality of education.

The article describes a way of ensuring the quality of blended teaching as a partial result of the project "Rationalization of education at Trnava University in Trnava". The issue of quality in e-learning is discussed in the second part, the basic framework of the project and the methods and technologies are described in detail further. Partial results obtained during the two years of the project are discussed at the end.

2. Quality of e-learning

E-learning as a term refers to a variety of different forms of technology-supported learning, usually characterized as the application of knowledge, information and educational technology to link people to each other and / or with educational resources, for the purpose of education (formal or informal) (Ehlers & Hilera, 2012). Quality in e-learning is understood in two contexts: "quality through e-learning", which refers to the quality of education in general by means of the use of e-learning tools; the quality of e-learning itself that is the subject of improving the quality of e-learning as such, is the second one. (Teodora et al., 2013)

Auvinen and Peltonen (cited in Dobre, 2012). indicate that the quality of education can be defined from three perspectives: technological, economic and pedagogical. The quality standards were associated with particular outcomes in the past. This meant that quality was evaluated on the base of courses quality and pre-defined learning outcomes. This approach changed in recent years. According to Bremer (Bremer, 2012), process-oriented approaches began to prevail. This means that not only the output, but also the quality of the entire process is subject to evaluation.

Thair et al. (Thair, Garnett, & King, 2006) defined the quality in the context of higher education as a following combination of organization activities:

- Improving core activities (teaching, research and institution services)
- Alignment of activities, budget and resources with the strategic plan
- Demonstration of leadership and innovation in all activities
- Exploration of the needs of students, other customers, stakeholders and the market
- Investing in human resource development
- Use of data, information and knowledge for decision making
- Improving outcomes

In the literature, one can find a number of other models, frameworks and recommendations for quality assurance in e-learning e.g. (Marshall, 2012; Masoumi & Lindström, 2012; Saatz & Kienle, 2013; Udo, Bagchi, & Kirs, 2011; Zhang & Cheng, 2012) The fact that the quality principles of successful technology-supported learning are the same as those in the traditional classroom, was one of the basic premise of the initial approach. The fundamental requirement of this premise is that well-designed learning activities will ensure success regardless of the means (technology). It must be said that e-learning is not just another way of implementation of traditional teaching, but it is a new approach to education. The methods of quality assurance must take in the account this fact. (Masoumi & Lindström, 2012)

The level of quality, usually achieved, can be assessed by the two ways: through benchmarking or by the specification of standards. Benchmarking means the comparison of performance and results achieved by the evaluated entity against the results and performance of the entity operating under comparable conditions. When standards are defined, the performance is set by comparing them with standards. Although benchmarking is a complex process to be applied at universities (Oliver, 2005), in e-learning context is used. The initiative "Excellence +" under the auspices of the European Association of Distance Teaching Universities (EADTU) and "The e-learning benchmarking exercise" of European Centre for Strategic Management of Universities (ESMU) can be referenced as an example. (Ebba Ossiannilsson, 2011)

Currently, there are standards and recommendations for quality in e-learning (for example, the Institute for Higher Education Policy; Learning Object Metadata (LOM) Learning Technology Standards Committee (LTSC), the Quality Assurance Agency). (Oliver, 2005) The intensive research in this field is visible at present while "the best practices" (Agariya & Singh, 2012; Al-Mushasha & Nassuora, 2012; Yee, 2013) that can be used as potential performance standards, are often published.

The quality of traditional teaching at a university is not homogeneous and varies from subject to subject, so varied quality of e-learning within one university can be observed, as well. (Oliver, 2005) To eliminate this diverse level of quality, it is necessary to implement a system of quality that ensures the required minimum level of e-learning quality across the university. That was the basic idea, which resulted in the project at Trnava University in Trnava".

3. Description of the project

This project is focused on pilot testing of methods and tools that consistently enhance the quality of education, while education is considered in various combinations of traditional and technology-supported learning assuming a decisive share of blended learning i.e. combination of traditional teaching with e-learning. The extent of technology integration in education is dependent on the particular subject, the preferred style of teaching, the teacher's competence and the like. Methods, tools and system model are being implemented (2014) at the university as a whole. A number of activities, procedures and steps, directly or indirectly affecting the quality of education and covering not only the education process, but also all related areas, such as university-related legislation, financing, organization and management of education, technical, human and other information assumptions, has been tested during the project.

The entire project is divided into four main activities:

- Design and verification of a system of direct measurement of quality in higher education
- Design and verification of actions to enhance the quality of higher education
- Design and verification of actions to eliminate information inequality in relation to public
- Design and verification of evaluation of the results of actions

The following outputs were implemented within the first activity:

- a) Extension of infrastructure for the deployment of technological support of education as a tool for improving the quality of higher education and tool for obtaining data for direct measurement of quality in higher education
- b) Design of pilot blended courses within the mathematics and computer science study programs
- c) Method for e-learning courses design
- d) Users of infrastructure and tools were trained
- e) Design of a system of direct measurement of quality in higher education

f) Verification of a system of direct measurement of quality in higher education

The extension of infrastructure for technological support of learning as a tool for improving the quality of higher education and tool for obtaining data for direct measurement of the quality of higher education include:

- Learning Management System - (LMS) - a support system that creates the conditions for and allows education, management, provision and evaluation of blended courses, obtaining feedback from students and teachers.
- Virtual Classroom - Web Conferencing - is a system that allows a teacher to meet with students using computers and the Internet, while the teacher can transmit voice, images from a web camera, and share his desktop where he can start a slideshow or any other application that is the content of education. This step contributes to the improvement of the educational process by allowing the students to follow the lectures when they are ill or during the preparation for an exam or just need to repeat some parts of lectures.

The Virtual Classroom expands the implementation of blended learning, which can be managed through a learning management system (LMS) as the virtual classroom is directly integrated with the LMS so that:

- Online lectures, directly accessible via the LMS can be planned within the course
- Online lectures records can be included among educational resources
- It is possible to organize an interactive online seminar and make it available through the LMS

It has been necessary to prepare the educational content of blended e-learning and then verify the quality of education after finishing the infrastructure for the implementation of e-learning and the tool for data mining system for direct measurement of the quality of education.

This part of the project took place in the following phases:

- Developing of methodologies
- Design of courses content
- Digitization - processing of course content into electronic form for online and blended learning.

Developed methodology covers the following activities:

- Design of courses and training materials concepts:
 - didactic concept
 - graphic concept
- Create a script templates for e-learning courses
- Defining rules for creating media (animations, illustrations, audio ...)

The content for the purpose of the blended pilot courses has been developed by the authors of content, which were teachers of the following five subjects: Geometry II, Algebra I, Mathematics, Operating Systems and Computer Architecture, and Database Systems I.

The Design of Quality measurement system is based on the Kirkpatrick model (Kirkpatrick & Kirkpatrick, 2007) of measuring the effectiveness of training. This model was developed at the University of Wisconsin in the United States and includes four levels of evaluation: reaction, learning, behavior, and results.

The reaction is quantitatively measurable by questionnaire, where student's satisfaction with the presented content, its form, methods of education, teacher etc. can be determined. Questionnaires were filled electronically using the LMS. Gained knowledge, skills and habits have been measured within the second level - Teaching. Within the design and verification of a direct measurement of the quality of education system we have focused on such ways of obtaining results that minimize subjective influences manifested increasingly in oral examinations. The pre-tests and post-tests were conducted electronically using the LMS. Behavior is the most important level of measuring quality, but at the same time, the most difficult to obtain the necessary data and their evaluation. It is a measurement of the actual transfer of knowledge, experience and attitudes into practice. This is done usually by questionnaire or checklist, while it is necessary to leave some time for the maturity of knowledge obtained by e-learning. This means that the measurement is carried out after some time after the course is finished. Questionnaires were made electronically using the learning management system. The fourth level of quality measurement, results, checks whether students perform tasks better, if their efficiency, accuracy and overall productivity increased. In accordance

with the originally designed Kirkpatrick model, this level is focused on practical learning outcomes through the measurement of the financial benefit from a graduate. The effect cannot be measured directly in money at universities. Therefore, the above model has been adapted (Misut, Pribilova, Orolinova, & Kotulakova, 2013) for university education. The practical benefit is seen as the improvement of student competences in the university education process and was evaluated through surveys of students and teachers with a time lag.

Design and verification of measures for enhancement of the higher education quality in a study program, Teaching of Mathematics and Computer Science, was a goal of second activity. The results of the quality measurements system have shown weaknesses in the education process quality and directed us to the areas where it was necessary to propose activities for quality improvement. In this activity, we have proposed concrete actions in different areas which have a direct and indirect impact on the quality of education. These areas are:

- Educational material
- Structure / virtual environment
- Communication, collaboration and interactivity
- Student Assessment
- Flexibility and adaptability of education
- Support (students and staff)
- The skills and experience
- Vision of the use of e-learning
- Allocation of resources
- A holistic aspect

The application of innovative forms of education requires new approaches to the educational process and also to the management of the University introducing innovative processes. Changes in individual areas cannot be implemented in isolation. It is necessary to proceed systematically, based on the plan that addresses activities for enhancement of the quality of higher education globally.

We have chosen for implementation, based on the analysis of European policy and quality education projects and practices of national organizations such as the eEurope Action Plan, Horizontal E-Learning Integrated Observation System (HELIOS), Sustainable Environment for the Evaluation of Quality in E-Learning (SeeQuence), European University Quality in eLearning (Enrique's), European Foundation for quality in eLearning (EFQUEL), European Association for quality Assurance in Higher Education (ENQA) and others, a Model of e-learning quality (Åström, 2008). The following methodologies and strategies have been developed within the implementation of this model:

- The methodology for the creation of digital materials, including concrete pedagogical and technical criteria (methodological and didactic concept of educational materials)
- Explicit strategy for communication, collaboration and interactivity depending on the educational requirements, availability of technology and human resources
- Strategy for fair and flexible system of student assessment
- Strategy for improving the flexibility and adaptability of education, based on the pedagogical point of view and students' needs
- Strategy to support students, teachers and organizations, including technical, administrative and social support on request
- A strategy for the development of teachers' skills
- Strategic plan for e-learning with long-term perspective
- Strategy of existing resources reallocation and creation of new resources according to the needs of e-learning

The implementation of the proposed short-term actions has been made within the project through an action plan.

The aim of the third activity was the implementation of a tool capable of effectively eliminating the information disparity between university and public. Implementation of a modern communication tool (University wiki) that can not only eliminate the information disparity, but also effectively share knowledge, build social networks, share information and discussion, create and share web pages, documents and multimedia content, etc. was the basis for this activity. Two-way communication is the advantage of wiki. This means that in contrast to the static web pages

designed primarily for university communications towards the public, the wiki system allows communication in the opposite direction from the public to the university, as well. This element has been mainly used to obtain feedback on the published information through public discussion and evaluation of the content.

To check the results we used electronic questionnaires for students, teachers and the public, through which we investigated whether the information deemed to be sufficient and understandable, respectively what information the public is interested in and what it would like to know more about.

Wiki is a tool that is used after successful implementations as:

- Collaborative tool
- University's intranet publishing tool
- Tool for creating learning materials
- Tool to reduce e-mail communication
- Blogging tool and more

The activity *Design and results verification of actions for the education quality improvement*, based on a system of direct quality measurement, is the logical outcome of a project. This activity examines the professional aspects and actions applicability for enhancement of the higher education quality.

Inputs for this activity are the strategies defined for each area of the actions for that method of assessment and verification of these inputs have been proposed. Implementation of this activity is based on the execution of multiple, interlinked activities:

- A proposal of the individual actions results evaluation
- A proposal of overall outcome evaluation
- Verification of the evaluation

Nine areas, for which actions are formalized in the respective strategies, have been proposed during the activity. Individual actions are not formulated as directly measurable variables, but together they help to raise the quality of education, which is measured on the basis of a direct quality measurement system, proposed in the first activity. Currently, the perception of the applied changes, as well as fulfillment of different strategies, recommendations and plans defined as outputs of previous activities is carried out through electronic questionnaires and personal interviews with target groups. To quantify the benefits of the proposed measures, the quality measurement processes were applied to the other groups of respondents after short-term activities had been implemented. Evaluation of taken activities effect will be possible by comparison of gained results with the results of first processes quality measurement. The output of this activity will be in a form of report containing the results of the measures for all covered areas.

4. Conclusions

Data from the first direct quality measurement are being currently analyzed along with tests and questionnaires for all four levels of evaluation (05/2014). Measuring of quality through pre-tests and post-tests is finished. Data collection for the fourth step of adapted Kirkpatrick model will be completed in the coming weeks. Then the contribution of the e-learning quality model implementation will be possible to evaluate.

Implemented technologies are already part of the standard learning process and they are used in other educational units, as well. Positive feedback from students at the beginning of the university wiki and integrating virtual classrooms in the LMS is dominant. This fact is perceived only by the immediate feedback at present. The actual effect will be shown after the end of the analysis. Therefore, the conclusion is open, although so far the data is supporting positive expectations. It is already clear that proposed methodological materials and practical recommendations on development of education content, on communication of e-learning participants, the recommendations relating to the organization of education, proposals for legislative changes regarding the rights and obligations of e-learning participants, counting work load of teachers in e-learning and others positively influence not only the quality of education, but also the overall improvement of attitudes of e-learning participants, and thus the overall atmosphere of the institution.

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