Improvement of Technical Quality of Virtual Learning Environments

Eugenijus Kurilovas
Vilniaus universiteto Matematikos ir informatikos instituto mokslo darbuotojas daktaras
Vilnius University Institute of Mathematics and Informatics, Research Scientist, PhD
Akademijos g. 4, LT-08663 Vilnius, Lietuva
Tel. (+370 5) 2 10 97 32, faks. (+370 5) 2 72 92 09
Vilniaus Gedimino technikos universiteto Informacinių technologijų katedros docentas
Vilnius Gediminas Technical University, Information Technologies Department, Associate Professor
Saulėtekio al. 11, LT-10223 Vilnius, Lietuva
El. paštas: *Eugenijus.Kurilovas@itc.smm.lt*

Irina Vinogradova
Vilniaus universiteto Matematikos ir informatikos instituto doktorantė
Vilnius University Institute of Mathematics and Informatics, PhD student
Akademijos g. 4, LT-08663 Vilnius, Lietuva
Tel. (+370 5) 210 97 32, faks. (+370 5) 272 92 09
Vilniaus Gedimino technikos universiteto Informacinių technologijų katedros lektorė
Vilnius Gediminas Technical University, Information Technologies Department, Lecturer
Saulėtekio al. 11, LT-10223 Vilnius, Lietuva
Tel. (+370 5) 2 74 50 35, faks. (+370 5) 2 37 06 25
El. pa tas: *irinav@vgtu.lt*

The paper is aimed to analyze which Virtual Learning Environment (VLE) tools are most useful for students in the learning process, and to propose the trends for VLE quality improvement considering the existing comprehensive VLE technical quality evaluation model. Lithuanian university students survey was organised for this purpose. The results show that the VLE personalization quality evaluation criterion is most useful for students in the learning process, while the adaptivity criterion was ranked lower. Several trends are proposed to improve VLE adaptivity and overall adaptation quality.

Introduction

Today, there is an increasing interest to the so-called "active" and "rich" pedagogies that originate in various socio-constructivist schools of thought. There are multiple reasons for this interest. "Traditional" pedagogies are very efficient for "knowledge transmission" but often lead to fragmentary and superficial knowledge difficult to integrate and to apply. In the modern changing world, there is an increasing need that the students become better general problem solvers and better group workers. Finally, there is a pressure to make learning more fun in order to spark students' individual interest.

According to Britain and Liber (2004), in the heart of a rich, active and open pedagogical scenario there are the students' activities mediated through products. In simpler terms, students have to create something. According to Schneider (2004), the reason why Dewey, Papert and others have advocated learning from projects rather than from isolated problems is, in part, that students can face the task of formulating their own problems, guided, on the one hand, by general goals they set and, on the other hand, by the 'interesting' phenomena and difficulties they discover through their interaction with the environment. Van Merrienboer and Pass (2003) consider that the powerful learning environments aimed at the development of general problem skills, deeper conceptual understanding and more applicable knowledge should include the following characteristics:

- the use of complex, realistic and challenging problems that elicit in learners' active and constructive processes of knowledge and skill acquisition;
- inclusion of small-group, collaborative work and ample opportunities for interaction, communication and co-operation; and
- the encouragement of learners to set their own goals and provision of guidance for students in taking more responsibility for their own learning activities and processes.

Modern and active pedagogies are more successful if the teacher can profit creatively from information and communication technologies (ICT) according to his and his students' needs. There are different kinds of ICT tools and systems to support various pedagogies, among them the so-called e-learning platforms, Virtual Learning Environments (VLE), Learning Management Systems (LMS), Content Management Systems, etc.

There are many different VLEs solutions – proprietary and open source, very expensive and free of charge. Despite the large variety of VLE software, there is no ideal VLE to satisfy all expectations.

According to Kurilovas (2005), education providers using VLEs have two primary aims:

- to enhance the quality of teaching and learning by allowing teachers to use the pedagogies that are not possible with large numbers in a face-to-face environment; and
- to manage the delivery and administration of programmes of learning through an electronic (on-line) medium. This includes management of groups of students.

The term "virtual learning environment" is used here as "a single piece of software, accessed via a standard web browser, which provides and integrated online learning environment" (Kurilovas, 2006).

VLE is commonly known as a specific information system which provides the possibility to create and use different learning scenarios and methods. It is a system designed to support teaching and learning in an educational setting, differently from the Managed Learning Environment where the focus is on management. A VLE will normally work over the Internet and provide a collection of tools such as those for assessment (particularly of types that can be marked automatically, such as multiple choice), communication, uploading of content, return of students' work, peer assessment, administration of

student groups, collecting and organizing student grades, questionnaires, tracking tools, etc. New features in these systems include wikis, blogs, RSS and other Web 2.0 tools as well as 3D virtual learning spaces. While originally created for distance education, VLEs are now most often used to supplement traditional face-to-face classroom activities commonly known as Blended Learning. These systems usually run on servers, to serve the course to students Multimedia and/or web pages.

A VLE should make it possible for a course designer to present to students, through a single, consistent, and intuitive interface, all the components required for a course of education or training. Although logically it is not a requirement, in practice VLEs always make an extensive use of computers and the Internet. A VLE should implement all the following elements:

- the syllabus for the course;
- administrative information, including the location of sessions, details of pre-requisites and co-requisites, credit information, and how to get help;
- a notice board for up-to-date course information;
- student registration and tracking facilities, if necessary with the payment options;
- basic teaching materials – these may be the complete content of the course, if the VLE is being used in a distance learning context, or copies of learning objects (LOs) used in lectures or other classes where it is being used to support a campus-based course;
- additional learning resources, including reading materials, and links to outside resources in libraries and on the Internet;
- self-assessment quizzes which can be scored automatically;
- formal assessment procedures;
- electronic communication support including e-mail, threaded discussions and a chat room, with or without a moderator;
- differential access rights for the instructors and students;
- production of documentation and statistics on the course in the format required for institutional administration and quality control;
- easy authoring tools for creating the necessary documents including the insertion of hyperlinks – though it is acceptable for the VLE to be designed allowing standard word processors or other office software to be used for authoring, etc.

All these facilities should be capable of being hyperlinked together. In addition, the VLE should be capable of supporting numerous courses, so that students and instructors in a given institution (and across institutions) experience a consistent interface when moving from one course to another.

There are a number of VLE tools to suit the particular learner needs.

There are also a number of methods suitable to evaluate the technical quality of VLEs. One of the most suitable of them is the Expert evaluation which is referred here as a multiple criteria evaluation of the learning software, aimed at the selection of the best alternative based on score-ranking results (Kurilovas and Dagienė, 2009b). This approach is suitable here because VLE quality evaluation is a typical multiple criteria decision analysis task where there is a number of VLE soft-

ware package alternatives to choose, and a number of alternatives' quality evaluation criteria which are usually conflicting, because VLE alternatives could be very qualitative against some criteria and not qualitative against another ones, and vice versa. There is also a number of stakeholders such as VLE vendors, education policy makers, educational institutions and practitioners (e.g., teachers), and their interests are often conflicting, too. This approach consists of the quality criteria model (i.e., a comprehensive system of quality criteria under which the experts should judge the proposed VLE alternatives), and the evaluation method based on the experts' additive utility function considering the sum of the values of all quality criteria multiplied by their weights (Kurilovas and Dagienė, 2009b).

Therefore, first of all we need some scientific principles or concepts to establish the quality evaluation model. Belton and Stewart (2002) have formulated a system of quality evaluation criteria formation concepts for the multiple criteria decision analysis tasks. They are as follows:

- value relevance;
- understandability;
- measurability;
- non-redundancy (e.g., is there more than one criterion measure the same factor?);
- judgmental independence (e.g., criteria are not judgmentally independent if preferences with respect to a single criterion, or trade-offs between two criteria, depend on the level of another);
- balancing completeness and conciseness;
- operationality – it is important that the model is not faced with special requirements (e.g., very long time) for decision makers. Model context is important;
- simplicity versus complexity – at the beginning of the practice we have too many details, creating the model an unnecessary things can be sieved.

Using these concepts for quality structure principles, Kurilovas and Dagienė (2009a) have created a comprehensive VLE technical evaluation model (a system of criteria), which consists of two sets of criteria: general i.e. internal quality criteria, and adaptation, i.e. quality in use criteria (see Fig. 1).

According to this technical quality criteria classification principle formulated by Kurilovas and Dagienė (2009 a, b), any technical quality evaluation model (set of criteria) for learning software packages (VLEs in our case) should provide experts (decision-makers) with a clear instrumentality of who (i.e. what kind of experts) should analyse and what kind of the software quality criteria in order to select the best software alternative suitable for their needs. Software engineering experts should analyse 'internal quality' criteria based on the scientific informatics engineering knowledge, and the programmers and users (e.g., teachers and students) should analyse 'quality in use' criteria based on the users' feedback, design and usability issues, etc. Therefore, users / students are quite suitable experts who can evaluate the VLE adaptation ('quality in use') criteria using, e.g., the survey method employed in the research presented below.

The most important VLE 'quality in use' criteria for students are 'personalization aspects' (i.e. facilities of each individual user to customize his/her view of the platform) and 'adaptivity' (i.e. all kinds

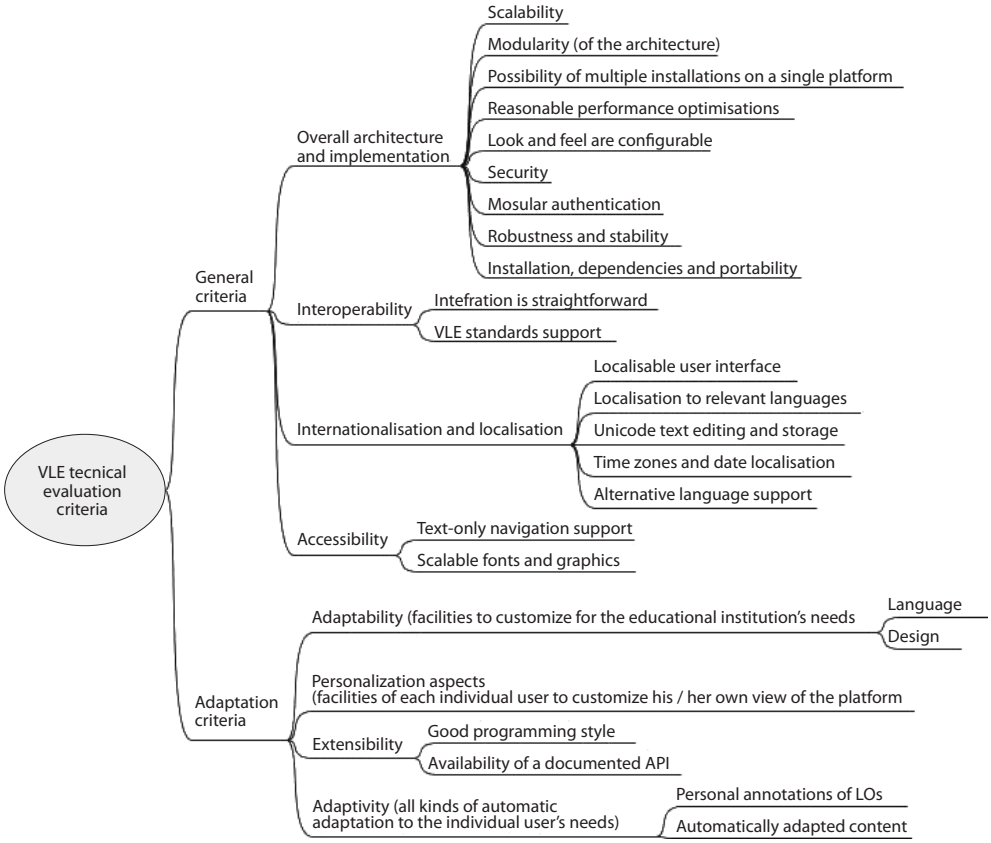

Figure 1. ***VLE technical evaluation criteria*** *(Kurilovas and Dagiene, 2009a)*

of automatic adaptation to the individual user's needs, e.g., personal annotation of learning objects – LOs) (see Fig. 1).

This confirms the scientific insight and priorities of European Union's 7th Framework Programme for Research and Technological Development, which argue that a new personalized, adaptive, intuitive informatics and collaborative technology will create assumptions for a faster and more precise search of quality learning content, which has a significant impact on learning.

According to Graf and List (2005), the 'personalisation aspects' adaptation criterion should indicate the facilities of each individual user to customise his / her own view of the VLE, and the 'adaptivity' criterion indicates all kinds of automatic adaptation to the individual user's needs (e.g., personal annotations of LOs or automatically adapted content). 'Personalization' here is treated as VLE adjustment to different individuals or groups. 'Adaptivity' is considered as a deeper personalization level, when VLE constantly adjusts to the learner changing needs. A series of scientific research show that the current VLEs have not enough adaptivity capabilities (especially automatic).

The aim of the survey presented below is to analyze which VLE tools (functions)

and, accordingly, VLEsquality evaluation adaptation criteria are most useful for students in the learning process.

Results

The most popular universities of Vilnius, Kaunas and Klaipeda have been working with distance learning systems for about ten years. The Kaunas University of Technology (KTU), Vilnius Gediminas Technical University (VGTU) and Vilnius University (VU) have up Distance Learning Centers, Klaipeda University (KU) and Vilnius Pedagogical University (VPU) began working with virtual training systems. The KU has set up the Distance Learning Center last year, and the VPU has set up a distance classroom three years ago.

The Distance Learning Centers methodically prepare teachers for the development of distance education courses. Accreditation of distance learning courses and quality control systems are applied in these centers. Courses are assessed by the groups of specialists in different educational areas and distance learning. Universities evaluate courses according to quality evaluation criteria established within a particular institution. Each institution's quality criteria are formulated in a different way, but all of them are based on preparing distance learning material and requirements for using interactive tools. Distance courses are evaluated according to their structure, goals and objectives, knowledge system, presentation of material, interaction, accessibility, students' testing system, collaboration tools and help for studying, etc. Universities are working with Moodle, IBM Workplace Collaborative Learning, WebCT (Blackboard) virtual learning environments.

In total, 198 respondents (students) from five Lithuanian Universities (VGTU, KTU, VU, KU, and VPU) have participated in the survey. They were VGTU second-year students on investment management, international business management, internet technology and real estate, construction economics and business, distance learning information technology, business process management technology for remote part-time graduate study programs, undergraduate students, VGTU and KTU joint masters and part-time students, VPU second-year master students of Informatics, KTU fourth-year bachelors, and VU second-year students in international communication master's degree.

VLE quality evaluation criteria selected for the research are based on the VLE adaptation criteria group, namely "Personalization' and 'Adaptivity' criteria (see Figure 1), because these criteria are most important for students, since "Adaptability' and 'Extensibility' criteria are important mostly for the education institutions (e.g., universities). The VLE tools most useful in the learning process were defined by the students.

Eight criteria were created for evaluating VLE tools (functions), and the results of the students' survey are presented in Table 1. The total and average results were calculated. The more average are the total ranks, the more important is the number.

Figure 2 shows that all VLE tools (functions) have a certain level of impact on the learning quality.

Table 2 shows how VLE tools analysed in Table 1 match the VLE adaptation quality criteria (see Figure 1), namely "personalization aspects' and adaptivity.

The sum of the amounts of the VLE evaluation criteria shows that, according

Table 1. ***VLE total and average numbers***

Numbers	Total	Average
VLE uses the same means of communication (there is no need to install additional means of communication, it helps to save time)	725	0.102
VLE allows us to see a full contact list of the whole group	959	0.135
In VLE, a student feels monitored by the teacher. This fact makes the student to visit more often the VLE	473	0.066
VLE contains all the necessary information about important dates (lectures, conferences, billing, etc.). The most important reports are placed on the first page of the VLE. Rational presentation of this information saves time	1386	0.194
Educational process includes VLE communication and collaboration tools (forums, chat rooms, exchange files, e-mail, group work, presentation tools, etc.)	889	0.125
Educational process uses a convenient and simple course of navigation and search systems	1026	0.144
Educational process is applicable to high-quality self-testing modes of presentation (which shows the result of student preparation and the student's references to the lecturer position)	1165	0.163
Educational processes are subject to the possibility of real-time communication	505	0.071

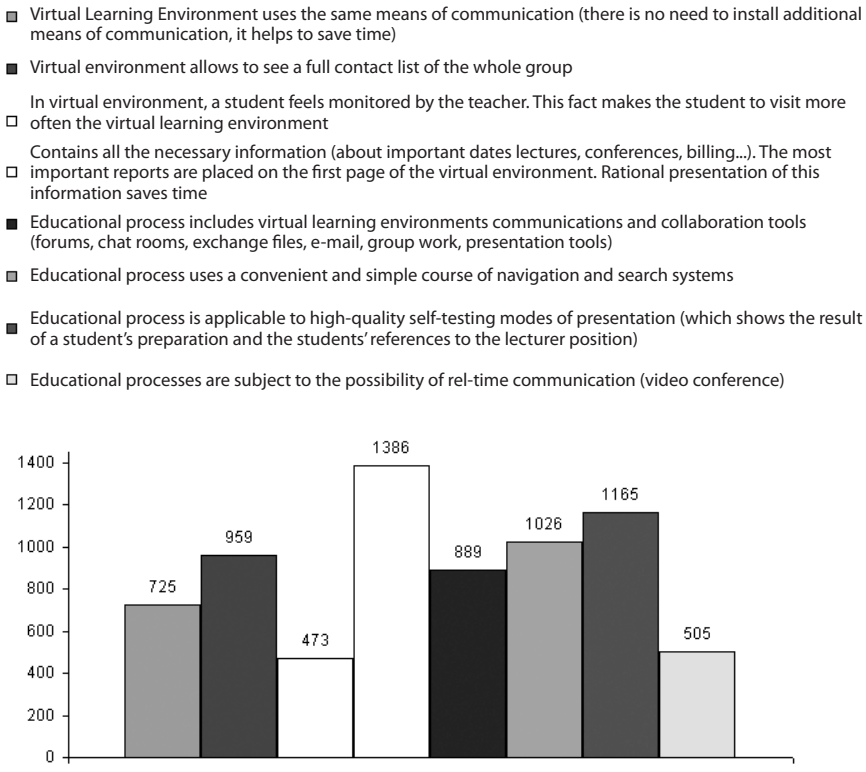

Figure 2. ***VLE functional quality evaluation criteria***

Table 2. ***Conformity of VLE tools (functions) and VLE quality criteria***

VLE tools (functional) criteria	VLE quality criteria
VLE uses the same means of communication (there is no need to install additional means of communication, it helps to save time)	Personalization aspects
VLE allows to see a full contact list of the whole group	Personalization aspects
In VLE, a student feels monitored by the teacher. This fact makes the student to visit more often the virtual learning environment	Personalization aspects
VLE contains all the necessary information about important dates. The most important reports are placed on the first page of the virtual environment. Rational presentation of this information saves time	Personalization aspects
Educational process includes VLE communication and collaboration tools (forums, chat rooms, exchange files, e-mail, group work, etc.)	Adaptivity
Educational process uses a convenient and simple course of navigation and search systems	Adaptivity
Educational process is applicable to high-quality self-testing modes of presentation (which shows the result of a student's preparation and the student's references to the lecturer position)	Adaptivity
Educational processes are subject to the possibility of real-time communication (e.g., video conference)	Personalization aspects

to the survey results, the 'Personalization aspects' evaluation criterion, from the students' point of view, should have a greater influence on the quality of learning.

The results of the study show that the VLE adaptivity criterion is also quite important for the quality of learning, but it was ranked lower by the students.

The survey results also show that the most important VLE technical tool used in the learning process is the notice board function, which provides all necessary information about the organization of the learning process.

A number of research studies show that currently universities pay insufficient attention to VLE adaptability and overall adaptation quality criteria and often use VLEs with insufficient adaptation capabilities. There are several main trends and methods of improving VLE adaptation capabilities known in the scientific literature. According to Vinogradova and Kurilovas (2010), several artificial intelligence methods are usable for this purpose; here, the flexible and independent program agents play the tutors' role, and different optimization methods such as vector optimization and heuristics are employed. There are also a number of the newest VLE adapta-

Table 3. ***VLE quality criteria evaluation total by numbers***

Total	
Personalization aspects	**Adaptivity**
473	889
505	1026
725	1165
959	**3080**
1386	
4048	

tion methods analysed in the scientific literature, such as the methods of modelling of the learners' styles (Popescu, 2009), the VLE Moodle extension method to support creation of advanced adaptable distance learning courses (Komlenov et al., 2010), the concepts of Intelligent Adaptive Learning Environment – (IALE) (Pedrazzoli et. al., 2009) and Adaptive Learning Environments – (ALE) (Oneto et al., 2009).

Conclusions and recommendations

In the adaptation quality criteria group, the most important VLE quality criteria for students are personalization and adaptivity. The results of the study show that, in the students' opinion, the VLE personalization quality evaluation criterion is most useful in the learning process, while the adaptivity criterion is ranked lower. It can be explained by the fact that the VLEs used in Lithuanian universities are of quite a low adaptivity level.

In order to ensure a higher learning efficiency, it is recommended to choose VLEs with a higher personalization quality level and to improve the VLE adaptivity level by using the new scientific methods proposed in the paper.

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VIRTUALIOSIOS MOKYMOSI APLINKOS TECHNINĖS KOKYBĖS TOBULINIMAS

Eugenijus Kurilovas, Irina Vinogradova

S a n t r a u k a

Šio darbo tikslas – išanalizuoti, kurios virtualiosios mokymosi aplinkos (VMA) priemonės yra svarbiausios mokymosi procese ir, atsižvelgiant į visapusišką VMA techninės kokybės modelį, pasiūlyti VMA tobulinimo kryptis. Šiam tikslui buvo organizuota Lietuvos universitetų studentų apklausa. Tyrimo rezultatai rodo, kad, studentų nuomone, mokymosi procese VMA personalizavimo kokybės kriterijai yra svarbesni už VMA adaptavimo kriterijus. Straipsnyje analizuojamos kelios VMA adaptyvumo ir apskritai adaptavimo kokybės tobulinimo kryptys.