

Grade Conversion Model for Joint E-Learning Courses

Jurgita Lieponiene
 Dept. of Technological Sciences, Panevezys
 College,
 Panevezys, Lithuania
 e-mail: jurgita.lieponiene@gmail.com

Regina Kulvietiene
 Dept. of Information Technologies, Vilnius
 Gediminas Technical University,
 Vilnius, Lithuania
 e-mail: regina.kulvietiene@gama.vtu.lt

Danguole Rutkauskiene
 Dept. of Multimedia Engineering, Kaunas University of Technology,
 Kaunas, Lithuania
 e-mail: danguole.rutkauskiene@ktu.lt

Abstract—Whereas higher education flows into the international study environment, the development of e-Learning takes on higher significance. E-Learning is becoming a means to implement virtual student mobility. Virtual student mobility can be realized by giving joint e-Learning courses. Joint e-Learning courses are e-Learning courses that are delivered for students from different countries. New tendencies of e-Learning development put forward new demands to e-Learning systems. The application of e-Learning systems for giving joint e-Learning courses includes the support of multilingual user's interfaces, the possibilities of the giving a course content in several languages, and the functions of the grades conversion into the grading scale of student's institution. The article evaluates the application of e-Learning systems for giving joint e-Learning courses and presents a newly created model of the grades conversion from one grading scale to another. The article also describes the integration of a new created model into *Moodle* system.

Keywords-e-Learning; e-Learning system; virtual student mobility; joint e-Learning courses; grades conversion; plugin of e-Learning system.

I. INTRODUCTION

The priorities of the improvement of the common European higher education environment within the upcoming decade are defined in the communiqué 'The Bologna Process 2020 - The European Higher Education Area in the new decade' [19]. Among them, we enumerate the growth of study accessibility for all social groups, orientation towards student's needs and expectations, the encouragement of students and teachers' mobility, the development of international honesty, and learning from the cradle to the grave.

E-Learning is a means to implement the regulation of Bologna process. The researches have proved that e-Learning makes studying more attractive, allows improving study quality not only in technological, but also in pedagogical terms. E-Learning is a means to implement the mobility of virtual students, to expand united study programs. According to Euler et al. [10], e-Learning is a tool that facilitates the servicing of a new market; it offers the potential to enhance the programme profile of a given university to include other services, as well as being used for the enhancement of university teaching and the

implementation of internationalization in education. According to Banks [3], e-Learning is seen as part of globalization to build capacity in 'borderless' education and distance learning, thus improving the competitiveness and marketization of higher education and impact on international cooperation and student mobility.

The changes in higher education environment put forward new demands to e-Learning systems. Whereas higher education is internationalized, e-Learning systems should correspond to new tendencies. They should be adapted to give joint e-Learning courses and should correspond to the needs of students from different countries. E-Learning systems should include the support of multilingual user's interface, the possibilities of the giving a course content in several languages, and the functions for grade conversion into the grading scale of student's institution.

The purpose of the article is to review the application of e-Learning systems for the giving joint e-Learning courses, to present a new created model of the converting of grades from one grading scale to another, and to describe the integration of a newly created model into *Moodle* system [16].

This paper is organized as follows. Section 2 discusses related works. Section 3 analyses the application of e-Learning systems for the giving of joint e-Learning courses. Section 4 presents a new created model of the converting of grades from one grading scale to another. Section 5 describes the integration of a new created model into *Moodle* system. Finally, Section 6 presents our conclusions.

II. RELATED WORKS

The research interest in the internationalization of e-Learning systems constantly increasing. Englisch et al. [9] emphasizes that due to internalization in university study programs more and more multilingual study courses are released. Multilingual support is very important because of globalization [7]. To extend e-Learning systems on a huge number of suppliers and users, multilingual content is necessary [9]. Most of the current available e-Learning systems have an individual implementation of multilingualism [9]. Some of them offer multilingualism only for system text, but not for the user content [9].

Englich et al. [9] presents a general approach for handling of multilingual content in e-Learning systems.

Denev et al. [7] analyses multilingual support for e-Learning systems and presents multilingual e-Learning solution. Hillier [13] analyses the problems of translation, presents the model for multilingual website.

According to Chen [6], learners’ cultural perceptions and experiences influence their online collaboration and communication behavior. When learning communities transcend nations and cultures, this potential influence must be taken into considerations in the design of online courses for cross-cultural collaborative online learning [6]. Mirza et al. [15] emphasizes that the barriers associated with the cultural differences in learning environments become more and more important with the increasing globalization of education. According to Blanchard et al. [5], if the content in a global e-Learning activity is not adapted in function of the culture, there are risks that learners of different culture background consider the same concept in different manners.

Chen [6] presents the design of a cross-cultural e-learning 2.0 environment, which fosters a learning community and facilitates collaborative learning. Blanchard et al. [5] creates a new kind of system called Culturally AWARE System that is centred on Culturally Intelligent Agents, i.e. agents that are able to understand and adapt to cultural specificities of learners. Edmundson [8] presents the cultural adaptation process model as a preliminary guideline for adapting e-learning courses for other cultures.

The performed analysis of literature has shown that scientists analyse the issues, relating to the application of e-learning systems to different cultural and language environments however the aspects of internalization of e-learning systems, evaluating the differences between studies results assessment systems are not studied.

III. THE APPLICATION OF E-LEARNING SYSTEMS FOR THE GIVING OF JOINT E-LEARNING COURSES

Analyzing the application of e-Learning systems for the giving of joint e-Learning courses three open-code e-Learning systems used in Lithuanian higher schools were assessed: *Moodle*, *ATutor* and *Sakai*. In 2010, the questioning of higher schools organized by LieDM coordination centre showed that *Moodle* system is used by 18 higher schools, *Sakai* – by 2 higher schools, *ATutor* – by 1 higher school [18]. *Moodle* system is widely used in Lithuanian and world higher schools. *Sakai* system is ranked very high in the world; however in Lithuania, it is little used. The researches of *Sakai* implementation were started in Siauliai University. *ATutor* system is not popular among Lithuanian higher schools; however, it is applied in secondary schools of Lithuania. In 2006, on the ground of this system, the virtual learning environment of Schools’ improvement program was created.

The assessment of e-Learning systems included the analysis of the documentation of the systems under consideration on the ground of the research results of various authors [1][2][11]. The application of e-Learning systems for giving joint e-Learning courses was analyzed according to different aspects: the support of multilingual user’s interface, the possibilities of giving the course content in several languages, and the functions of the grades conversion into the grading scale of student’s

institution. The conducted research are summarized in Table 1.

TABLE I. THE EVALUATION OF THE APPLICATION OF E-LEARNING SYSTEMS FOR THE GIVING OF JOINT E-LEARNING COURSES

| Criterion | Moodle 2.4 | ATutor 2.1 | Sakai 1.4.3 |
|-------------------------------------------|------------|------------|-------------|
| Multiple language user interface supports | yes | yes | yes |
| Navigation between interface languages | yes | no | no |
| Multiple language content | yes | no | no |
| Grades conversion function | no | no | no |

The conducted analysis showed that e-Learning systems under consideration can work in several language environments. *Moodle* user interface is translated to 112 different foreign languages. *ATutor* supports 71 different foreign languages. *Sakai* supports 20 different foreign languages. Adapting user’s interface of the e-Learning system to different languages, menu items and all text variables that can be visible to user are translated. The translation is saved in the separate files that are incorporated in the e-Learning system structure. These files translate the e-Learning system interface, and not the course content.

In *Moodle* system, users can choose the language of interface. User can choose the most appropriate language for him or her from language menu. However, this language choice influences only the interface of e-Learning system.

Multiple language content can be created in *Moodle* system. The multi-language content filter in *Moodle* enables resources to be created in multiple languages.

In e-Learning systems under consideration for the assessment of students’ study results it is possible to apply or create different study result grading scales corresponding to the needs of the institution. However, none of the systems under analysis has an integrated grades conversion function which enables the presentation of grades on the student’s study results grading scale.

Summarizing the results of the conducted analysis, it is possible to state that the application of e-Learning systems for the giving joint e-Learning courses is not fully implemented. Although the typical feature of *Moodle* system is functional multilingual user’s interface and the possibilities of multilingual content creation are implemented, however because of the unresolved questions of the compatibility of study result grading scales, the giving of joint e-Learning courses remains a problematic issue. Thus, e-Learning systems should be improved.

IV. GRADES CONVERSION MODEL

The problem of grades conversion is solved in the works of various authors. In 1997, Haug [12] examined the differences of grading scales used in different countries and emphasized that assessment interpretation is was not more objective than an assessment process itself. The uncertainty of grades conversion is influenced both by the difference of used grading scales and by the different practice of the use of these grading scales. The conversion of grades into ECTS (*European Credit Transfer and Accumulation System*) grading scale received high interest.

Nunes et al. [17] described the method of assessment converting into ECTS grading scale emphasizing separate valid in Portugal converting cases. Warfvinge [20] provided the model of grades conversion into ECTS grading scale.

For conversion of grades in e-Learning systems, two-parameter grades conversion model was created. This model should be applied for conversion of both standard and criteria based grading scale grades. When converting the positive grades from one studies results grading scale to another, the model takes into consideration two parameters, i. e. the distribution of the accumulated control positive grade set data on the grading scale A and the distribution of the accumulated control positive grade set data on the grading scale B. After labeling the parameters by letters L, K, the attribution of the equivalent b_j of positive grade a_i on the grading scale A to the grading scale B can be defined as a two-parameter function (1).

$$a_i = f(L, K, b_j) \quad i = \overline{1, n}, \quad j = \overline{1, m} \quad (1)$$

The data of grading scales A and B are written as probability distributions (2). Since in some countries incremental grading scales are used, while decreasing scales are used in others, the marking of the scales is also different and a new variables, i. e., the assessment indexes i and j are introduced. The assessment indexes number the scale positive grades in the decreasing order and correspond to the characteristic of the distributions.

$$p_{A_i} = P(X = i), \quad i = \overline{1, n}, \quad p_{B_j} = P(Y = j), \quad j = \overline{1, m} \quad (2)$$

For conversion of assessments from the grading scale A to the grading scale B, a two-dimensional probability distribution is formed with the values (i, j) , $i = \overline{1, n}$, $j = \overline{1, m}$ (3). The probability p_{ij} of the value (i, j) is the probability that the learner's knowledge and abilities, assessed by a grade with index i on the grading scale A, will be assessed by a grade with the index j on the grading scale B.

$$p_{ij} = P(X = i, Y = j), \quad i = \overline{1, n}, \quad j = \overline{1, m} \quad (3)$$

The probabilities of the two-dimensional probability distribution are calculated by applying formula (4):

$$p_{ij} = \min(p_{A_i} - \sum_{k=0}^{j-1} p_{ik}; p_{B_j} - \sum_{k=0}^{i-1} p_{kj}), \quad i = \overline{1, n}, \quad j = \overline{1, m} \quad (4)$$

$$p_{i0} = 0, \quad p_{0j} = 0$$

The positive grade equivalent is attributed on the basis of the formed two-dimensional probability distribution. In case the assessments are not rates, the grade is attributed the most probable equivalent (5).

$$a_i = b_k, \text{ if } p_{ik} = \max(p_{i1}, p_{i2}, \dots, p_{im}), \quad i = \overline{1, n} \quad (5)$$

In case the probabilities of several grades are equal, the maximum assessment equivalent is used, i. e., the grade

with the lowest assessment index. The positive grade a_i on the grading scale A corresponds to the positive grade b_k on the grading scale B, in case the probability of the distribution value (i, k) satisfies the relations, described by equations (6).

$$a_i = b_k, \text{ if } p_{ik} = \max(p_{i1}, p_{i2}, \dots, p_{im}),$$

$$\text{if } p_{ik} = p_{il}, \text{ then } k < l, \quad i = \overline{1, n} \quad (6)$$

In case the students are rated, the grades are sorted in the order of decreasing of the assessment value and the corresponding rating is given to each assessment. The number s_{ki} of the assessments, corresponding to the convertible grade a_i is redistributed by applying formula (7). The assessment b_1 corresponds to the s_{i1} of the highest assessments a_i , b_2 – the s_{i2} of the following assessments a_i , etc.

$$s_{ij} = \left[\frac{\sum_{k=1}^j \frac{p_{ik}}{\sum_{l=1}^m p_{il}} * s_{ki} + 0,5}{\sum_{k=0}^{j-1} s_{ik}} \right] \quad i = \overline{1, n}, \quad j = \overline{1, m},$$

$$s_{i0} = 0 \quad (7)$$

In case the rating of the convertible grade a_i in the assessments set under analysis is r , the assessment rating a_i is in the grade group v , the number rsk_r of the assessments, corresponding to the rating is redistributed by applying the formula (8). The c_{r1}^i of the highest assessments of rating r corresponds to assessment b_1 , b_2 corresponds to the c_{r2}^i of the following assessments of rating r , etc.

$$c_{rj}^i = \min(s_{ij} - \sum_{k=0}^{v-1} c_{kj}^i; rsk_r - \sum_{k=0}^{j-1} c_{rk}^i), \quad i = \overline{1, n}, \quad j = \overline{1, m} \quad (8)$$

$$c_{0j}^i = 0, \quad c_{r0}^i = 0$$

The grade a_i of the rating r corresponds to grade b_k on the grading scale B, in case the relations, described by equation (9) are satisfied.

$$a_i = b_k, \text{ if } c_{rk}^i = \max(c_{r1}^i, c_{r2}^i, \dots, c_{rm}^i), \quad i = \overline{1, n}, \quad k = \overline{1, m} \quad (9)$$

$$\text{if } c_{rk}^i = c_{rl}^i, \text{ then } k < l$$

E-Learning systems should correspond to the modern tendencies of e-Learning results assessment alteration. In order to implement the idea of learning without walls, to implement virtual student mobility it is necessary to integrate the grades conversion model into e-Learning systems. The results of students' study should be given on the study result grading scale of their country, institution – only then the grades will provide comprehensive reversible information. Thus, continuing the experimental research the grades conversion module was created and integrated into e-Learning system.

V. INTEGRATION OF THE GRADES CONVERSION MODEL INTO E.LEARNING SYSTEM MOODLE

In order to conduct an experimental research, the e-Learning system Moodle was chosen. Moodle system was chosen by various reasons: software license, reliability, functionality. The results of the conducted research showed that Moodle system, in comparison to other open-code e-Learning systems used in Lithuania, is most of all adapted to give joint e-Learning courses.

The grades conversion model was integrated into the

Moodle system by developing a separate Moodle system module. The grades conversion module is a plugin of the Moodle system, developed in observance of the rules for and methods of development of the Moodle system plugins and corresponding to the Moodle plugins technologies. In order to implement the module the PHP (Hypertext Pre-processor), HTML (Hyper text Markup Language), MySQL and CSS (Cascading Style Sheets) technologies were used. The Moodle system integrated the grades conversion model by extending gradebook functions and adding a new gradebook report module Fig. 1.

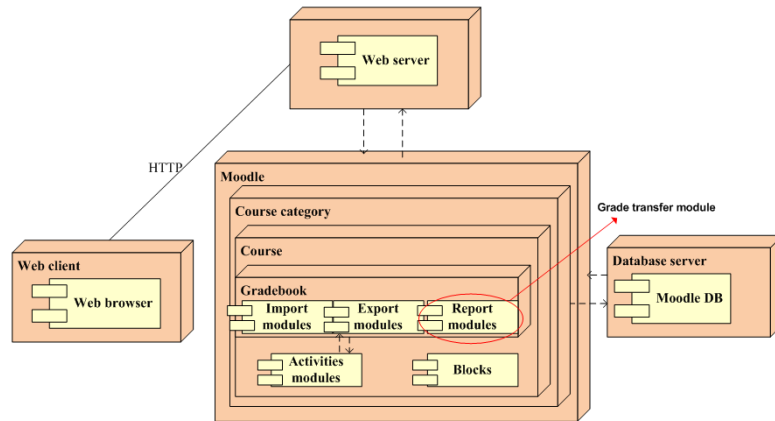


Figure 1. Grades conversion module integration into Moodle system components diagram.

The created report module of the gradebook consists of the files intended for module reliability and performance, style, to describe module regulation, to renew the structure of database, to indicate access control.

When integrating the grades conversion module database scheme into the overall structure of the Moodle database, the new database tables were developed and the already existing ones were updated. The logical scheme of the database of the grades conversion module is provided in Fig. 2.

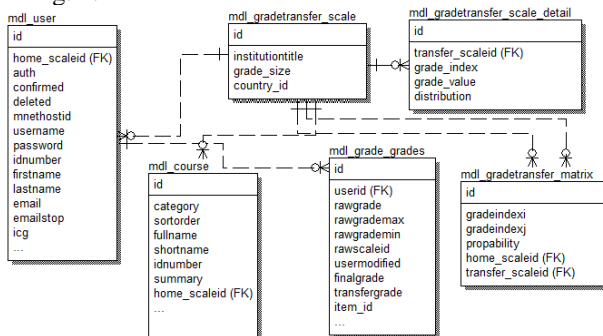


Figure 2. Logical database scheme of grades conversion module.

The report module of the gradebook was created adhering to the general principles of the creation of Moodle modules. The main file of grades conversion module is *index.php*. First of all, this file reads configuration parameters, includes necessary libraries, fulfils the check of the conditions of access control, forms the report corresponding to the user's access rights or displays error message.

The reliability and performance of the report module of the gradebook was described creating new, renewing and using standard Moodle class methods. Created grades conversion method is executed each time after the recalculation of grades. At the initial stage of grades conversion, necessary grades conversion conditions are checked, i.e. it is established if a grading scale is attached to the course, if there are changeable elements of a course gradebook. If necessary conditions of grades conversion are satisfactory, the grades should be converted for the selected students. During the selection of students, it is checked whether a student got a grading scale which does not match a course grading scale, if a student belongs to a group whose students' grades were recalculated. If the list of students meeting the defined conditions of grades conversion is empty, then grades conversion process is suspended.

After the selection of students, it is checked if necessary grades conversion tables have been formed. If a grades' conversion table corresponding to a course and student grades scales is not made, the method of the formation of this tables is executed. Only those grades of changeable elements of the gradebook are converted which belong to selected students. Making the tables of grades distribution according to ratings, rating process is executed at the group level. The conversion process of the grades of the gradebook is detailed in the grades conversion activity diagram given in Fig. 3.

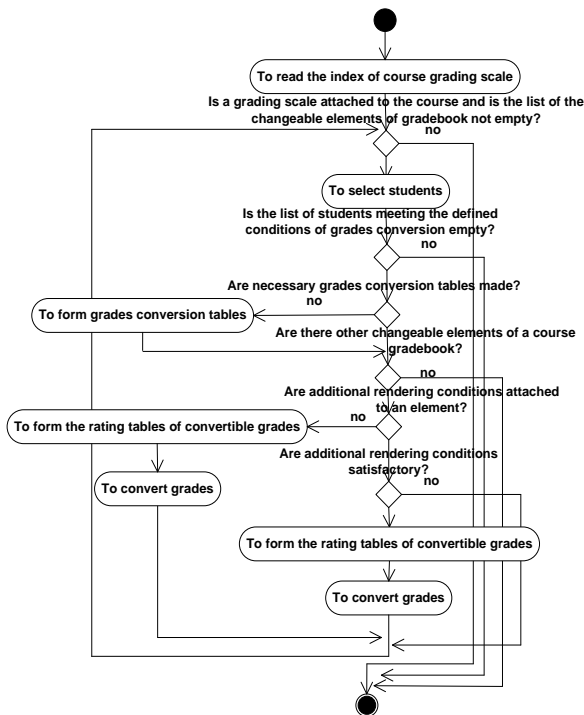


Figure 3. Activity diagram of gradebook's grades conversion.

When a course teacher defines a course gradebook and establishes the formula of the calculation of the final grade, a student can keep a check on grades changes both on the study results grading scale of the institution giving studies, and on student's study results grading scale. After the student opens the course gradebook, he/she sees the grades on two grading scales. The grades, recalculated to the studies results grading scale of the educational institution, represented by the learner provide comprehensive information to the learner. The student is able to realistically evaluate the achieved results.

A picture given below presents the student's gradebook report. This report shows a student his grades on the grading scale of the institution giving studies (field *Grade*) and also on this student's grading scale (field *Transfer grade*). A picture given below shows gradebook report of student whose institution applies literal A-F study results grading scale (Figure 4.).

| Grade item | Grade | Range | Percentage | Transfer grade |
|-----------------------------------------|-------------|-------------|----------------|----------------|
| Database design | | | | |
| Test | | | | |
| Relation technology fundamentals. Test. | 7.00 | 0-10 | 70.00 % | C |
| Database design tool CA ERWIN. Test | 8.00 | 0-10 | 80.00 % | B |
| SQL language. Test | 9.33 | 0-10 | 93.33 % | A |
| Average of test | 8.00 | 0-10 | 80.00 % | B |
| Control works | | | | |
| Logical and physical data model | 9.00 | 0-10 | 90.00 % | A |
| Normalizing data to design tables | 9.00 | 0-10 | 90.00 % | A |
| SQL language | 9.00 | 0-10 | 90.00 % | A |
| Average of control works | 9.00 | 0-10 | 90.00 % | A |
| Independent work | 7.00 | 0-10 | 70.00 % | C |
| Exam | 7.00 | 0-10 | 70.00 % | C |
| Final grade | 7.70 | 0-10 | 77.00 % | C |

Figure 4. Gradebook report of student.

The grades conversion module extends the functionality of the Moodle system. It is flexibly integrated into the overall structure of the Moodle system. The supplementation of the gradebook with the grades conversion function is relevant when there is a need to give joint e-Learning courses to learners from different countries.

VI. CONCLUSIONS AND FUTURE WORK

Users' interfaces of the open code systems Moodle, ATutor, Sakai used in Lithuania are translated into different foreign languages. The users of Moodle system can easily change the language of user's interface; this system has the possibilities of the creation of multilingual content. However, none of the systems under consideration has integrated grades conversion function which is important when giving joint e-Learning courses for students from different countries.

Grades conversion model have been developed. The grades conversion model considers the accumulated grades distribution data on the convertible studies results grading scales and converts the grades by employing the principle of the most probable grades equivalent, taking into consideration the grades rating in the group of the analysed grades.

The grades conversion algorithm is integrated into the Moodle system, by expanding the gradebook functions and developing a new Moodle system gradebook report module. The scheme of the grades conversion module database is integrated into the common structure of the Moodle database, the control of access to the grades conversion model is defined and the functionality of the module is described.

Further we plan to extend grade conversion model including the impact of such factors as language barrier, cultural differences.

REFERENCES

- [1] C. C. Aydin and G. Tirkes, "Open source learning management systems in distance learning," The Turkish Online Journal of Educational Technology, vol. 9, pp. 175-185, April 2010.
- [2] A. Al-Ajlan and A. Zedan., "Why Moodle," Future Trends of Distributed Computing Systems, pp. 58-64, October 2008.
- [3] S. Banks, "Collaboration for inter-cultural e-Learning: A Sino-UK case study" Proceedings of the 23rd Annual Ascilite Conference, The University of Sydney, pp. 71-77, December 2006.
- [4] E. Blanchard and C. Frasson, "Making Intelligent Tutoring Systems culturally aware: The use of Hofstede's cultural dimensions," International Conference on Artificial Intelligence, Las Vegas, pp. 644-649, June 2005.
- [5] E. Blanchard, R. Razaki, and C. Frasson, "Cross-Cultural Adaptation of e-Learning Contents: a Methodology," International Conference on e-Learning, pp. 112-120, July 2005
- [6] S. Chen, Ch. Hsu, and W. Ursuline, "Designing E-learning 2.0 Environment for Cross-cultural Collaborative Learning," Society for Information Technology & Teacher

- Education International Conference, pp. 98-105, June 2009.
- [7] D. Denev, A. Boichev, and P. Nedelchev. "Multilingual Support of e-Learning Systems: The Bulgarian Contribution," International Conference on Computer Systems and Technologies - CompSysTech'06, pp. 85-92, June 2006.
- [8] A. L. Edmundson, "The Cross-Cultural Dimensions of Globalized E-Learning," Global Information Technologies: Concepts, Methodologies, Tools, and Applications, pp. 382-393, 2008.
- [9] N. Englisch, A. Heller, and W. Hardt, "A Generic Approach for Multilingual Content in Learning Management Systems," ICERI2013 Proceedings, pp. 312-318, November 2013
- [10] D. Euler, S. Seufert, and F. Moser, "Business models for the sustainable implementation of e-Learning at universities", Handbook on Information Technologies for Education and Training, pp. 295-315, 2008.
- [11] F. Fislser and F. Schneider, "Creating, Handling and Implementing E-Learning Courses Using the Open Source Tools OLAT and eLML at the University of Zurich," Proceedings of the World Congress on Engineering and Computer Science, pp. 50-57, October 2009.
- [12] G. Haug, "Capturing the Message Conveyed by Grades. Interpreting Foreign Grades," World Education News & Reviews, vol. 10(2), pp. 25-31, 1997.
- [13] M. Hillier, "The role of cultural context in multilingual website usability," Electronic Commerce Research and Applications, vol. 2(1), pp. 2-14, 2003.
- [14] J. Lieponiene, "The Research of E-Learning results' assessment technologies". Doctoral dissertation, pp. 134, 2012.
- [15] M. Mirza and A. Chatterjee, "The Impact of Culture on Personalization of Learning Environments: Some Theoretical Insights," PLE Conference Proceedings, pp. 56-61, July 2010.
- [16] Moodle - Open-source learning platform. [Online]. Available from: <https://moodle.org/> [retrieved: February, 2014]
- [17] S. Nunes, L. Ribeiro, and G. David, "Supporting the Bologna Process in HE Information Systems," EUNIS'2005 European University Information Systems, Manchester, pp. 27-33, June 2005.
- [18] D. Rutkauskiene, R. V. Musankoviene, and V. Krivickiene, "Common Services Needs for LieDM Network Members," E-Education: Science, Study & Business, pp. 149-154, November 2010.
- [19] The Bologna Process 2020 – The European Higher Education Area in the new decade. [Online]. Available from: [http://www.ehea.info/Uploads/\(1\)/Bologna%20Process%20Implementation%20Report.pdf](http://www.ehea.info/Uploads/(1)/Bologna%20Process%20Implementation%20Report.pdf) [retrieved: February, 2014]
- [20] P. Warfvinge, "A generic method for distribution and transfer of ECTS and other norm-referenced grades within student cohorts," European Journal of Engineering Education, vol. 33(4), pp. 453-462, September 2008.