International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:3, No:5, 2009

eLearning Tools Evaluation based on Quality Concept Distance Computing. A Case Study

Mihai Caramihai, and Irina Severin

***Abstract*—**Despite the extensive use of eLearning systems, there is no consensus on a standard framework for evaluating this kind of quality system. Hence, there is only a minimum set of tools that can supervise this judgment and gives information about the course content value. This paper presents two kinds of quality set evaluation indicators for eLearning courses based on the computational process of three known metrics, the Euclidian, Hamming and Levenshtein distances. The "distance" calculus is applied to standard evaluation templates (i.e. the European Commission Programme procedures vs. the AFNOR Z 76-001 Standard), determining a reference point in the evaluation of the e-learning course quality vs. the optimal concept(s). The case study, based on the results of project(s) developed in the framework of the European Programme "Leonardo da Vinci", with Romanian contractors, try to put into evidence the benefits of such a method.

***Keywords*—**eLearning, European programme, metrics, quality evaluation

I. Introduction

FROM a general point of view, eLearning can be used to increase the interaction between trainers and students and to make the learning experience more learners' centered. In spite of this, the approach can generate some issues, since students may feel isolated or less motivated [1]. Hence, the success of an on-line course from a learner point of view depends upon an excess of factors, e.g. "the quality of content, the applicability or relevance of learning style or pedagogy to the unit's objectives and the on-line environment, and the quality of the on-line environment itself" [2].

Meanwhile, it was a small number of analyses regarding researches on the quality of educational opportunities that Internet-based distance learning presents. While there are several studies [3], [4] which examined eLearning courses versus traditional formats, there is little data concerning the delivery of distance learning over the Internet.

Hence, as more vocational training courses develop an online presence, there is an increasing need to evaluate form and content in order to increase quality and usefulness. Different evaluation instruments were developed which can synthesize website design criteria with course development criteria.

The aim of this paper is to introduce a new set of quality evaluation indicators for e-learning courses based on the computational process of three known metrics: the Euclidian, Hamming and Levenshtein distances. The "distance" calculus will be applied to standard evaluation templates, determining a reference point in the evaluation of the eLearning course quality vs. the optimal concept(s). The final case study highlight how the projects developed within Leonardo da Vinci II Programme, during 2000 – 2006 period, with Romanian contractors, are more or less closer / broader from an "optimal" eLearning platform.

II. The *Leonardo da Vinci* Programme and the European eLearning Perspective

The European point of view regarding eLearning [5] was adopted by the European Commission and has identified four priority lines of action:

- improvement of infrastructures and equipment (Internet access in all classrooms, ratio of 5-15 pupils per multimedia computer),
- a training drive at all levels (digital literacy for all school leavers, promoting the use by teachers of digital technologies in education, creation of online learning platforms, adaptation of school curricula, etc),
- development of quality content and training services on the basis of different reference models,
- networking of schools in Europe.

Some situation overviews [6] have noticed a retard of objectives attainment in European Member States, but eLearning projects have shown positive return on investment. So, many organisations are currently reluctant to make the strategic decisions required to embrace eLearning for staff training. Largely, the eLearning European market and its offerings have matured not only concerning quality content, management and delivery, but also in terms of eLearning vendors to position offerings into the market. Some statistics per European countries as development, topics, and tendencies were detailed [7]. The quality assessment [6] of eLearning resources and eLearning offerings, in general, is an as important issue as the eLearning courseware and the interest for establishing an on-line evaluation methodology links the

Mihai Caramihai is Professor of Computer Science at POLITEHNICA University of Bucharest, and Expert with the European Commission / National Agency for Community Programmes in the Field of Education and Vocational Training, Romania (phone: +40.21.402.9167; fax: +40.21.402.9587; e-mail: m.caramihai@ieee.org

Irina Severin is Professor of Quality Engineering at POLITEHNICA University of Bucharest and Expert with the European Commission / National Agency for Community Programmes in the Field of Education and Vocational Training, Romania. (phone: +40.21.402.9541; e-mail: irina.severin@anpcdefp.ro).

tutors, the managers, the learners, all the above-mentioned specialists.

The *Leonardo da Vinci* Programme contributes to the implementation of a vocational training policy for the European Community which supports the actions of Member and Associated States. The programme was financed by the *European Commission* in two phases for the periods 1994 – 1999 and 2000 – 2006, respectively, with the aim to promote new practical approaches in vocational training policies. Actually, the Leonardo da Vinci programme was integrated in the Lifelong Learning Programme, financed for the period 2007-2013 and focused mainly on the same track – the vocational training (VET) policies in Europe.

According to the provisions of the Council Decision 1999/382/EC adopted to finance the *Leonardo da Vinci* programme second phase, the period 2000 – 2006 was covered through three calls for proposals: 2000 – 2002, 2003 – 2004, and 2005 – 2006. The particular objectives of the *Leonardo da Vinci* Programme, as established by the *European Commission* were:

1. To improve the skills and competencies of people, especially young people, in *initial vocational training* at all levels; this may be achieved inter-alia through work-linked vocational training and apprenticeship with a view to promoting employability and facilitating vocational *integration and reintegration*;
2. To improve the quality of, and access to, *continuing vocational training* and the lifelong acquisition of skills and competencies with a view to increase and develop adaptability, particularly in order to consolidate technological and organisational change;
3. To improve and reinforce the contribution of vocational training to the process of *innovation*, with a view to improve *competitiveness and entrepreneurship*, also in view of new employment possibilities; special attention will be paid in this respect to foster co-operation between vocational training institution, including universities and undertakings, particularly SMEs.

In the same time, the specific measures linked to the Programme can be structured as following:

- Procedure A: Mobility;
- Procedure B: Pilot projects (PP) including, Language competences (LA), Transnational networks (NT);
- Procedure C: Thematic actions (TH), Reference materials (RF), Complementary Actions.

The present study is focused on procedure B financed projects. Community support is available for the design, development, testing, evaluation and dissemination of innovative practices in terms of methods, content or products in the field of vocational training and guidance.

Pilot projects (PP) are intended to stimulate the process of innovation and to enhance the quality of training and vocational guidance. They develop tangible products, using new information and communication technologies where appropriate, and intangible products: new approaches in VET, new training methods, and new policies linked to professional development, etc.

The General Directorate for Education & Culture, responsible, among other European financing initiatives, for the *Leonardo da Vinci* Programme, has established a set of results/outputs assessment indicators. Among these descriptors, respectively the indicators proposed for results delivered in electronic format, one might select / adapt those appropriate indicators for eLearning resources as pilot projects results / outcomes. These final (qualitative) indicators can be briefly presented in Table I.

TABLE I
FINAL PRODUCTS: QUALITATIVE INDICATORS
(EUROPEAN COMMISSION PROCEDURE)

ASSESSMENT GRID→ PROCESS ↓	COMMUNICATION & MEDIA USED	EVALUATION	TECHNOLOGY / AUDIO-VIDEO AND ELECTRONIC SUPPORT
Final stage (Conducting the training course)	- quality of interaction between material and target group / course participant, - choice of media with respect to content	- assessment criteria and procedures, - ongoing and final assessment tests, - quality of feedback with respect to answers to self-assessment questions, - measurement of pathway target groups/course participants level of satisfaction	- material organization, - quality of image definition, - complementarity between sound and image - aesthetics) - material organization, - aesthetics, - ergonomics - use of media

Integrating learning, education and training concepts in the general approach of quality assurance, control and management framework, the related standards [8] - [10] should be considered. Quality control should be included in the results / products construction stage to enable assessment in accordance with aims, targets, values and strategic elements. A "reference" document drawn-up should be recommended. In the same time, tools should be built to measure: the pedagogical effectiveness, the effectiveness of technological tools and the educational support, the learners and others parties satisfaction and the cost per person.

In a broader sense, a more structured assessment approach should be carried out considering different times (analysis, construction, drawing up and conducting training course), by different participants (trainee, trainer, client company, sponsors or financiers, managers etc.) in order to assess the effects of the e-learning (assessment of satisfaction, assessment of learning, assessment of possible transfer to working situations). Several criteria and techniques may be suggested for each product development stage, as seen in Table II.

TABLE II
FINAL PRODUCTS: QUALITATIVE INDICATORS
(EUROPEAN COMMISSION PROCEDURE)

ASSESSMENT GRID→ PROCESS ↓	AIMS	TARGETS	CRITERIA	TECHNIQUES
Analysis stage	- coherence in relation to the aims and objectives of the participants - balance between skills/requirements of the project	-sponsors or financiers - managers - learners	- operative nature of the partnerships - rationalization of costs - conformity with aims and expectations	- analysis of documents - interviews - analysis grid
Construction stage	- conducting of the project - adjustment of resources to learners' characteristics - adjustment of the system to the constraints of the participants	- learners - designers - trainers	- acceptance by the participants - navigation through resources - educational effectiveness - monitoring of the elements of the contract	- satisfaction rating - log books - iterative approach
Drawing up stage	- acceptability of tools - usability of tools - ergonomic quality - technical reliability of the platform	- learners - trainers - content producers - technicians	- effectiveness of technologies used - accessibility	- tests of prototypes, - questionnaire / interview - statements of the difficulties of learners and trainers/producers - statistics of connection times,
Conducting the training course	- adherence - co-management - Adjustment of the service to learners' requirements and method of learning	- learners - tutors	- quality of formalization tools - speed and relevance of adjustments to the course - actual use of collaborative work systems	- identification of critical cases - recovery of experience (REX) - analysis of mistakes - contributions to forums etc. - assessment of learning - attendance rate at exams - dropout rate - number of "calls for help"

As it can be seen from both tables, quality eLearning approaches can be helpful for educational organizations but in the mean time there are quasi-different. The main issue is linked to the difficulty to compare (in a standard manner) the results obtained through both methods and to decide which of them is more appropriate to be used in the field.

III. eLEARNING COURSE EVALUATION

A. Mathematical Concept of Distance Computation

The computational process of Euclidian, Hamming and Levenshtein metrics for some project results (i.e. eLearning courses) will be presented below. The distance results give in all cases estimation about the "gap" between the project result(s) and the assessor attendance.

The Euclidean distance, or the Euclidian metric, represents the root of square differences between coordinates of two points/strings of equal length [11], i.e. the Euclidian distance for n-dimensional $X = (x_1, x_2, ...,x_n)$ and $Y = (y_1, y_2, ...,y_n)$ is computed as:

$$\sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + ... + (x_n - y_n)^2} \quad (1)$$

The Hamming distance represents the amount of difference for two strings of equal length, $X = (x_1, x_2, ..., x_n)$ and $Y = (y_1, y_2, ...,y_n)$, computed by counting the minimum number of substitutions needed to change one string into the other [11].

The Levenshtein distance is applicable also for strings of different length and is computed by counting the minimum number of operations (insertion, deletion or substitution of single characters) [11] needed to turn one string into the other.

B. Parametrization Process of eLearning Products Assessment

As already mentioned above, the assessment of eLearning products (for *Leonardo da Vinci* projects financed by the EC) is based on the following elements: communication & media used, evaluation, and technology / electronic support. In the framework of the present analysis, each of these elements will have a specific weight attached in order to point out its relevance vs. the final evaluation mark.

The final scoring system allows the configuration of the following quality levels: Scoring: 7.00 – 10, Good and very good: suitable for best practices; 5.00 – 6.99, Average; 3.00 – 4.99, Substandard: the grant must be returned (in proportion of 50%); below 3.00 Unacceptable, the grant must be

TABLE III
RANGE OF MARKS AND RELEVANCE OF ELEARNING PRODUCTS
(EC PROCEDURE)

CHARACTERISTICS OF THE EL PRODUCT	RANGE OF VALUES (MARKS)	SPECIFIC WEIGHT
communication & media used	0..10	25%
evaluation	0..10	40%
technology / electronic support	0..10	35%

TABLE IV
RANGE OF MMARKS AND RELEVANCE OF ELEARNING PRODUCTS
(CF. TO AFNOR Z 76-001)

CHARACTERISTICS OF THE EL PRODUCT	RANGE OF VALUES (MARKS)	SPECIFIC WEIGHT
Aims	0..10	15%
Targets	0..10	20%
Criteria	0..10	25%
Techniques	0..10	40%

recovered (in proportion of 100%). Of course, such an evaluation can be made during the project implementation too, in order to assess the evolution of results quality and to adjust all necessary corrections.

Hence, in this case, the Euclidian metric is the only one that will precisely indicate the amount of progress in the evolution / involution of the eLearning tool, the "direction" of correct implementation being established through the decrease of the specific distance. On the other hand, the Hamming / Levenshtein metrics can give only a measurement of the change / alteration level as consequence of the project / product implementation.

Starting from the same concept (eLearning product evaluation at final stage), only the last row from Table II can be considered, in accordance with the assessment criteria; in the Table IV it is proposed a scale of marks with their appropriate relevance.

IV. A Case Study: Simulation of Distance Evaluation for eLearning Tools

In accordance with the *quality criteria* and regulations established by the *European Commission* (EC) in framework of the *Leonardo da Vinci* Programme, a number of pilot projects with Romanian contractors were financed, respectively 8 projects in 2000 exercise, 6 projects in each 2001, 2002, 2003 and 2003 exercise, 3 in 2004 and 2 in 2006 (see fig. 1). These projects have proposed *different innovative training programmes developed in European transnational partnerships* (see www.leonardo.ro). The topics, the developed products and the partnership expertise implementing the project are detailed in the application form, further part of the financing agreement. The Romanian National Agency has the role to assess the projects final deliverables using the EC's assessment grid and to allocate the financial envelope in accordance to the products quality.

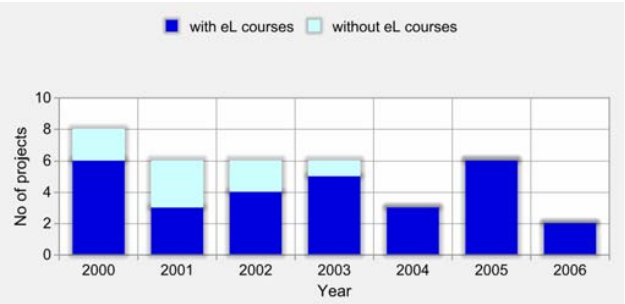

Fig. 1 Pilot projects – with Romanian contractors: the eLearning component proportion

To identify courses with online components, all project web servers were searched for relevant course and instructor names. Hence, five major project topics were identified based on their focuses (management, IT&C, social, life sciences and business) with different online course shares (see Fig. 2).

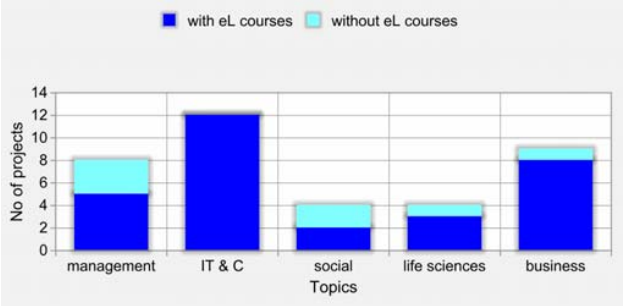

Fig. 2 Number of courses by topic with online components

In view of the IT&C courses which all have eLearning components, it was chosen the project No RO/05/B/F/PP-175004, entitled "New forms, Internet based and products for vocational and educational training (VET), Lifelong learning (LLL) and competencies assessment for the marine and port fields (e-MARINE)" promoted by the Maritime University, Constanta, Romania. The aim of the project (2006-2008) was to increase the employability through augmenting the level of instruction and the preparation for the harbours and maritime fields through ODL courses (based on eLearning & mLearning technologies). A number of six final courses were developed and assessed by independent evaluators. Based on the final marks, the following "distances" were obtained (founded on EC procedure and AFNOR Z 76-001 standard – Table V):

Whether the distance between the two procedures is calculated, it can be observed that only the Levenshtein method is applicable due to the fact that the individual strings are of different lengths.

The results presented in Table V demonstrate that the distance measured based on AFNOR Z 76-standard is more "refined" estimated that the other one, due in particular to the special focus on eLearning products and to the existence of specific analysis criteria consonant with target groups expectations.

TABLE V
Range of Distance vs. Procedures' Types (Average Values)

Procedure	Euclidian distance	Hamming distance	Levenshtein distance
EC procedure	9.47	0.3	0.3
AFNOR Z 76-001 standard	9.33	0.41	0.41

V. Conclusion

This paper presents two kinds of quality set evaluation indicators for eLearning courses based on the computational process of three known metrics: the Euclidian, Hamming and Levenshtein distances. The "distance" calculus is applied to standard evaluation templates (i.e. the European Commission Programme procedures vs. the AFNOR Z 76-001 Standard). The study doesn't envisage launching a debate concerning the

reliability of the EC's assessment procedures. Hence, for experts involved in the eLearning field, who need to make decisions regarding which assessment system to use for evaluation, it provides a possible approach for comparison of the various products available in the field. As such it can provide a basis for informed and rational decision making and avoid costly and quality nonconformities.

The assessment methods might be applied during the project implementation, too, in order to adjust appropriately the progress and to accomplish valuable results / products.

REFERENCES

[1] R. Krull, W. Wetmore, L. Ruggiero, M. Sharp, Applying Collaborative Technology to Learning in the Distance Classroom, Int. Prof. Comm. Conf., 2006, preprints, pp. 183 - 189
[2] S. Standing, T. Vasudavan, On-line learning and the issue of service quality, J. Sys. Inf. Tech., 2004, 8, pp. 23 – 29
[3] S. Rubin, S., Professors, Students, and the Syllabus, The Chronicle of Higher Education, 56, August 7, 1985.
[4] H. Gabennesch, The Enriched Syllabus: To Convey a Larger Vision, The National Teaching & Learning Forum, 4-5, 2002.
[5] The eLearning Initiative, 2001, http: //europa.eu.int/comm/elearning
[6] P. Riddy, K. Fill, Evaluating the quality of eLearning resources, British Educational Research Association Annual Conference, Heriot-Watt University, Edinburgh, 11-13 September 2003
[7] M. Kolding, Market Analysis European Corporate eLearning Market Forecast and Analysis, 2003-2007, IDC
[8] ISO / IEC 19796-1:2005, www.iso.ch
[9] AFNOR Z 76-001,
[10] ISO 9126, ISO 10007, ISO 9001, www.iso.ch
[11] D Parmenter, Key Performance Indicators, John Wiley & Sons 2007.

Mihai Caramihai is Professor of Computer Science at Politehnica University of Bucharest (where he has been since 1989) and Expert with the European Commission / National Agency for Community Programmes in the Field of Education and Vocational Training (Romania). Professor Caramihai is the author of more than 17 scientific books and 180 technical papers and is involved both in research and project management activities and he holds one patent deriving from his research. He is a member of 4 Royal Societies and more than 20 Professional Societies.

Irina Severin is Professor of Quality Engineering at Politehnica University of Bucharest and Expert with the European Commission / National Agency for Community Programmes in the Field of Education and Vocational Training (Romania). Professor Severin is the author of more than 8 scientific books and 60 technical papers and is involved both in research and project management activities.