Evaluation of E-learning Platforms: a Case Study

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In the recent past, a great number of e-learning platforms have been introduced on the market showing different characteristics and services. These platforms can be evaluated using multiple criteria and methods. This paper proposes a list of selected quality criteria for describing, characterizing and selecting e-learning platform. These criteria were designed based on e-learning standards. I also propose a mathematical model to determine the probability that a student uses an e-learning platform based on the factors (criteria) that determine the quality of the platform and the socio-demographic variables of the student. The case study presented is an application of the model and the input data, intermediate calculations and final results were processed using SAS (Statistical Analysis Software).
Keywords: *E-Learning Platform, E-Learning Standards, Learning Object, Logistic Regression, Quality Criteria List, Univariate Analysis*

1 Introduction

The World Wide Web is a repository of content (files, databases, datasets, images, video or audio clips, simulations, animations, etc.) of all known formats and standards. The excessively increasing load of information on the Internet leads to an inevitable overload of useless information or information for commercialization purposes. Teachers and students may not use this information for their educational need but rather as a global network for communication, interaction and sharing. Within the online context, the user can be a content "producer" and "consumer" simultaneously [1], thus leading to a huge amount of raw information, produced by a huge number of heterogeneous users without any didactic reformation applied and incapable to support classroom learning design. In the education sector, there is always a quality control procedure taking place against the educational material of the schools from the Ministry of Education. Therefore in the classical media context, is also need of multiple criteria and methods to approve the quality of e-learning content and e-learning software.

2 E-learning platform

Traditional means of learning restrict the learner to certain learning methods, at a specific time and place whereas e-learning services create wider horizons for organizations and individuals who are involved in the learning process. These environments facilitate the delivery of the learning materials so the learner can access them at home or at the office.

The most part of contemporary e-learning platform can be viewed as organized into three fundamental macro components: a Learning Management System (LMS), a Learning Content Management System (LCMS) and a Set of Tools for distributing training contents and for providing interaction [2]. The LMS integrates all the aspects for managing on-line teaching activities. The LCMS offers services that allow managing content of the units while the Set of Tools represents all the services that manage teaching processes and interactions between users (students, teachers, administrators).

An e-learning platform can be characterized through the following management services:

- services for including and updating user profile;
- services for creating courses and cataloguing them;
- services for creating tests described through a standard;
- user tracking services;
- services for managing reports on course frequency and use;

- services for creating, organizing and managing own training contents or contents provided by other producers [3].

3 E-learning standards

Importance and need of specifications and standards are well known to all of us in different areas of activity. Standards impose certain order providing more uniform and precise access and manipulation to e-learning resources and data. There are number of organizations working to develop specifications and standards such as: ADL, IMS, ARIADNE, IEEE, ISO etc to provide framework for e-learning architectures, to facilitate interoperability, content packaging, content management, Learning Object Metadata, course sequencing and many more [4].

The ADL (Advanced Distributed Learning) initiative "*is to provide access to the highest quality learning and performance aiding that can be tailored to individual needs, and delivered cost effectively at the right time and at the right place"* [5]. The ADL is accountable for the Sharable Content Object Reference Model (SCORM), a well-known and accepted standard for all users of e-learning platforms. This standard consists of three separate specifications:

- *Content Aggregation Model (CAM)* for assembling, labeling, and packaging of learning content. The basic units of interest in the Content Aggregation Model are Sharable Content Objects (SCO) and Content Packages that are used to deliver content
- *Run-Time Environment (RTE)* which includes *Launch* (describes how a LMS provides Content Packages to the learner), *Application Programming Interface* (communication interface between Content Packages and LMS during execution) and *Data Model* (LMS records the result of interaction between learner and learning object using data model).
- *Sequencing and Navigation (SN)* for sequencing and content navigation. This module controls and monitors the interaction between users and LMS. These specifications are based on IMS Consortium specifications.

Instructional Managements Systems (IMS) Global Learning Consortium is a consortium of e-learning solutions providers. The standard IMS focuses on the development of XML-based specifications. Several IMS specifications have become worldwide standards for delivering learning products and services:

- *IMS Content Packaging* specification *describes data structures that can be used to exchange data between systems that wish to import, export, aggregate, and disaggregate packages of content* [6];
- *IMS Learning Design* specification allows a wide range of teaching techniques in online learning;
- *IMS Meta-data* specification describes a learning object and allows to specify an annotation to search these educational resources efficiently;
- *IMS Question and Test Interoperability* describes a standard data model for representing the test items and reports evaluation results;
- *IMS Learner Information Package* is a collection of information about the learner (individual or group learners) or the producer of learning content (teachers or providers);
- *IMS ePortfolio* specification was created to make ePortfolios interoperable across different systems and institutions.

Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) has created a standards-based technology infrastructure that allows the publication and management of digital learning resources in an open and scalable way. ARIADNE aims to provide flexible, effective and efficient access to large-scale educational collections in a way that goes beyond what typical search engines provide[7].

IEEE Learning Technology Standards Committee (LTSC) "*is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for* *learning technology* [8].” The IEEE/LTSC is organized in working groups to develop different aspects of learning technology.

International Standardization Organization (ISO). A subcommittee of the worldwide operating standardization body ISO, the JTC1/SC 36 committee, is working on standardization issues in information technology for learning, education and training in liaison with the IEEE/LTSC. The ISO/JTC1/SC36 committee is organized into five workgroups on: vocabulary; collaborative technology; learner information; management and delivery of learning, education, and training; quality assurance and descriptive frameworks [9].

I would also like to propose several specifications for the quality of e-learning content (Learning Object, LO):

1. *LO objectives* – at the beginning of each LO teacher should clearly define the objectives, so the students should be aware of what they learn.
2. *LO should be designed by level of difficulty* – the students have not the same level of understanding, therefore teachers should design LO by level of difficulty (very advanced, advanced, average, beginner).
3. *LO should be completed within a certain time (i.e. from 5 to 15 minutes)* – the content of the LO should be limited to a certain period of time so students do not get bored.
4. *Glossary* – new terms should have a brief explanation in the glossary of each LO
5. *Recapitulation and summary* – at the beginning of each LO should be a presentation (recapitulation) of the concepts that should be known for a better understanding of the new content. At the end of the LO should be a summary of the learning content. Student may choose whether to read the entire content of the LO or just the summary.
6. *Detailed feedback on learning progress* - student should review certain chapters, paragraphs, etc.; teacher should highlight the positive aspects; student should access external links for more information.

4 Quality criteria list

The growing number of available e-learning systems and the commercialization of these systems highlight the necessity of quality evaluations of online published learning materials. Although quality evaluation of learning materials in e-learning systems have become increasingly important, the actual evaluation standards and methods for information quality (IQ) in such systems have not yet reached a consensus [10]. The evaluation of e-learning systems is important for all the actors involved in the learning process. Teachers and students need to evaluate the benefits of using e-learning in comparison with the classical methods of learning [11].

Evaluation of e-learning platforms requires evaluating not only the implementing software package (Learning Management System), but also the e-learning content (Learning Object). Both pedagogical and technological aspects must be carefully evaluated. The following quality criteria were developed based on the e-learning standards (i.e. Scorm, Learning Object Metadata, IMS Specifications, etc.).

I outline below six basic categories for the evaluation of the Learning Management System (functionality, communication/ collaboration, accessibility/effectiveness, management of e-learning content and users, administration, tools and technology) and others six categories for the evaluation of the Learning Objects (didactic and pedagogical evaluation, metadata, content evaluation, multimedia presentation, evaluation of the users, technology).

Table 1. Quality Criteria List

Learning Management System	Learning Object (LO)
A. Functionality	A. Didactic and Pedagogical Evaluation
A.1 Sequencing and Navigation Structure	A.1 LO should be design on different levels of difficulty (very advanced, advanced, average, beginner)
A.1.1 Paragraphs	A.2 LO for different learning profile
A.1.2 Menus	A.3 LO should be completed within a certain time (i.e. from 5 to 15 minutes)
A.1.3 External Links	A.4 LO objectives
A.1.4 Sitemap	A.5 Recapitulation LO
A.1.5 Search Engine	A.6 Summary LO
A.1.6 Smart Navigation	
B. Communication/Collaboration	B. Learning Object Metadata [12]
B.1 Email	B.1 General (i.e. title, description, keyword)
B.2 Forum	B.2 Life Cycle (i.e. version, status)
B.3 Chat	B.3 Meta-Metadata (i.e. identifier, metadata schema)
B.4 Web-blog	B.4 Technical (i.e. format, size, location)
B.5 Wiki	B.5 Educational (i.e. interactivity type, learning resource type, interactivity level)
B.6 Whiteboard	B.6 Rights (i.e. cost, copyright, description)
	B.7 Relation (i.e. kind, resource)
	B.8 Annotation (i.e. entity, date, description)
	B.9 Classification (i.e. purpose, description, keyword)
C. Accessibility/Effectiveness	C. Evaluation of the LO content
C.1 Access Status (free, payment, mixed)	C.1 Free-of-error
C.2 Multilingual Content	C.2 Relevance
C.3 Compliance to W3CWAI Standards	C.3 Accessibility
C.4 Plug-ins needed	C.4 Credibility/Validity
C.5 Users feedback for evaluation of e-learning platform	C.5 Updated
	C.6 Easy of manipulation
D. Management of e-learning content and users	D. Multimedia presentation
D.1 Progress report for users	D.1 Balance between textual and visual elements
D.2 Grade book	D.2 Attractive content presentation
D.3 Progress report for Learning	D.3 Entertainment games

Learning Management System	Learning Object (LO)
Object	
D.4 Export reports (i.e. Excel, PDF)	D.4 Educational games
E. Administration	E. LO for evaluation
E.1 User registration	E.1 Different items for evaluation (i.e. multiple choice, true/false, free text, empty spaces, drag and drop-matches)
E.1.1 Students	E.2 Initial evaluation (before the learning process)
E.1.2 Teachers	E.3 Final evaluation (at the end of the learning process)
E.1.3 Administrator	E.4 Feedback on learning progress
E.1.4 Other users (i.e. parents)	E.4.1 Students should review certain chapters, paragraphs, etc.
E.2 Templates for different user interface	E.4.2 Teachers should highlight the positive aspects
E.3 System settings	E.4.3 Students should access external links for more information
E.4 Management of user groups	
E.5 Backup System	
E.6 System Maintenance	
E.7 Other modules	
F. Tools and Technology	F. LO Technology
F.1 The e-learning platform can be access by a standard browser (the browser displays all the multimedia content)	F.1 Reusability - a single LO may be used in multiple contexts for multiple purposes
F.2 Friendly user interface	F.2 Interoperability - LO may be used by different e-learning platforms
F.3 Download speed of large information	F.3 LO can be aggregated – LO can be grouped into larger collections of content, including traditional course structures
F.4 Technical characteristics	F.4 LO are self-contained – each LO can be taken independently

5 The mathematical model used for the evaluation of e-learning platforms

The evaluation process consisted of the following steps:

- Construction of the sample (sample requirements, model performance, model development);
- Fine classing and univariate analysis of data;
- Multivariate analysis – linear regression and logistic regression;
- Correlation analysis;
- Validation of the model.

5.1 Construction of the sample

Variable whose value I wish to predict is called *the criterion* or *the dependent variable* and the variable whose value is used to predict the criterion is called *the predictor* or

the independent variable. In this case, the criterion variable is: *using an e-learning platform to meet certain quality criteria is enough for better understanding, learning and assessment knowledge* and the predictor variables are the quality criteria list (described in table 1) and socio-demographic characteristics of the student.
I used a survey to identify the training needs of the users. Example of question in the survey: *Do you consider the user's feedback important for the evaluation of an e-learning platforms ?*
Users may answer:
- Yes, I agree;
- No, I disagree;
- I don't know.

I say they are 'good' those who answer *yes, I agree,* 'bad' those who answer *no, I disagree*, and 'indeterminate' for those who are undecided. The goal is to build a model to discriminate between good and bad.

Table 2. GB classification

Group	Definition
Good	Yes, I agree
Bad	No, I disagree
Indeterminate	Other response

Sample requirements:
- Quite recently, in order to resemble with a real situation;
- Representative for the target population;
- To contain a sufficient number of bad, a minimum of 4%

Model performance: the event to be predicted is the probability that an user's answer is good. It is necessary to exclude all those undecided, for a good discrimination between good and bad.
Development and Hold-out sample: The database will be divided into two, respecting the original proportions (weights 70% - 30% or 80% - 20%):
- The base development, used for the model development;
- The base used for the validation of the model.

5.2 Fine classing and univariate analysis of data
Consists in amalgamating observations into a set of ranges or intervals to produce statistics (e.g. good/bad odds) that could not be produced for individual observations (as one observation is either good or bad). It is these intervals that undergo analysis and from which inferences can be drawn about the importance of a characteristic in the development.
There are many methods to determine an optimum number of intervals (e.g. Sturges method), but I consider enough that each interval to contain about 5% - 10 % from the base. Non-numeric variables will be grouped separately and analyzed in the same manner (e.g. gender, year of study, job, etc.). The purpose of the univariate analysis is to identify all the variables that can be considered as suitable predictors of the probability of a student being Good.
I calculate WoE (Weight of Evidence) which indicates that it is necessary to group multiple ranges into one.

$$WOE = \ln\left(\frac{\%good}{\%bad}\right)$$

A method of excluding variable that is not representative is given by Information Value, IV.

$$IV = \sum_k (\%good - \%bad) * WOE_k$$ k

represents number of groups.

Table 3. Measures of explanatory power

Power of explanation	Information Value	Gini Index
Low	<0.02	<10%
Medium	0.02 to 0.1	10% to 20%
Good	0.1 to 1	20% to 30%
Very good	> 1	> 30%

Gini Index is calculated by comparing the cumulative number of goods and bads by score. Graphically, it is the area between the two lines on the curve (XYW) expressed as a percentage of the maximum possible (XYZ). The two axes on the graph are cumulative percentage of goods (y-axis) and cumulative percentage of bads (x-axis).

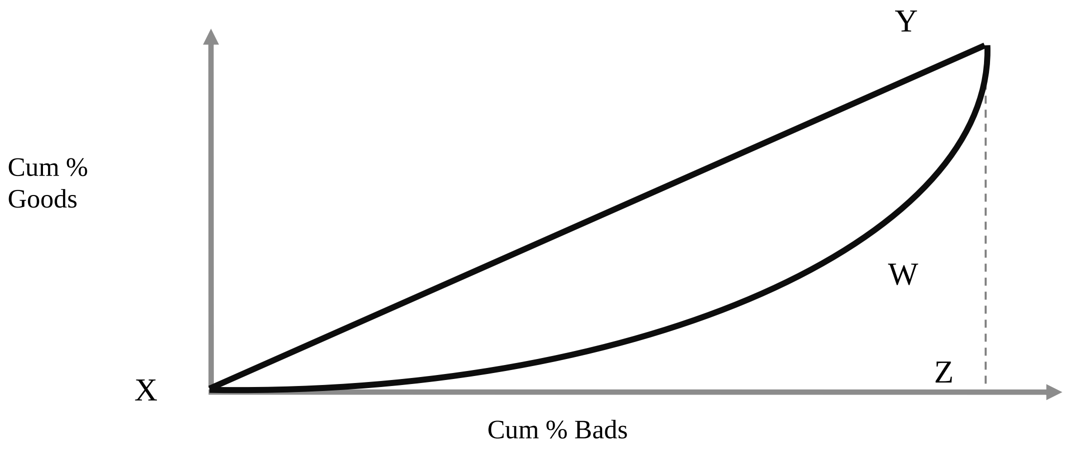

Fig. 1. Gini Index

Gini Index is calculated as follow:

- g_i = cumulative percentage of good at a given score;
- b_i = cumulative percentage of bad at a given score;
- S_n = the n-th score in the score distribution.

Using simple geometry, the area under the curve for a given score is defined as:

$$A_{score} = \frac{1}{2}(b_i - b_{i-1}) * (g_i + g_{i-1})$$

The total area of (XYZ) minus the total area of (XYW) is:

$$A_g = \sum_{i=S_2}^{S_n} A_i$$

The area of triangle (XYZ) is equal to:

$$A_T = \frac{1}{2}(100 * 100) = 5{,}000$$

The Gini coefficient is then calculated as the modulus of:

$$g = \frac{(A_T - A_g)}{A_T}$$

The result is between 0 and 1, as a proportion.

The Information Value measure is calculated as follows:

$$I = \sum_{i=1}^{n}\left[\left(\frac{g_i}{G} - \frac{b_i}{B}\right).\log\left(\frac{g_i.B}{b_i.G}\right)\right]$$

where G and B are the total number of good and bad respectively

5.3 Multivariate analysis – linear regression and logistic regression

Generalizing, the term Regression is used to characterize the way in which the measurement of an unobserved (or dependent) variable Y changes according to the measurements of one or more different events (the independent variables xi, i=1, 2, …). The purpose of a regression analysis is to quantify the relationship between the dependent and independent variables.

Linear regression: in linear regression the objective is to find an equation that links the latter to the former through a linear function:

$$Y = \beta_0 + \beta_1 X_1 + ... + \beta_n X_n + \varepsilon_i$$

The coefficients β_i represent the weights to apply to the value of the independent variables to estimate the dependent variable *Y*; the term ε_i is the error term, the difference between the actual and the predicted values of Y. The coefficients are determined so as to minimize the sum of the squared errors ε_i (Ordinary Least Squares criterion), but there are some other robust methods in presence of outliers in data.

Logistic regression – in logistic regression the unobserved variable Y is a Bernoullian random variable whose possible values are 0 and 1. The probability that Y can assume the value 1 depends on the regressors set $x_i\,(i = 1,2,...,n)$:

$$P(Y = 1 \mid X = x) = \pi(x), (1)$$

The procedure for estimating such a probability is based on the comparison (odds ratio) between the probability of an event happening and the probability that it does not happen:

$$odds(x) = \frac{P(Y=1 \mid X=x)}{P(Y=0 \mid X=x)} = \frac{P(Y=1 \mid X=x)}{1-P(Y=1 \mid X=x)} = \frac{\pi(x)}{1-\pi(x)}, (2)$$

The natural logarithm of the odds (logit) is a linear function of the regressors x_i:

$$\ln[odds(x)] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_n x_n, (3)$$

Combining formulas (2) and (3) and solving by π(x), the logistic function of probability estimation that the event happens is:

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 x_1 + ... + \beta_n x_n}}{1 + e^{\beta_0 + \beta_1 x_1 + ... + \beta_n x_n}}, (4)$$

The logistic regression makes use of maximum likelihood estimation methods for estimating the regressors.

The parameters β_i are estimated using Maximum-Likelihood Estimation. Maximum likelihood function is:

$$L = \prod \pi(x_i)^{y_i} [1 - \pi(x_i)]^{1-y_i}, (5)$$

Wald Test is used to test the statistical significance of each coefficient β in the model. This test is equivalent to *T -Test* used in linear regression. When the null hypothesis is rejected, I assume that the estimated parameter is significant (non zero), therefore *p-estimated* is below 5%:

$$p - estimat = 2 \times probnorm\left(\frac{\hat{\beta}_i}{S_{\hat{\beta}_i}}\right), \qquad \hat{\beta}_i \text{ -}$$

estimation of β_i and $S_{\hat{\beta}_i}$ - its dispersion (calculated as the root of diagonal covariance matrix)

Using SAS, all these statistics will be done using the procedure *proc logistic* and *backward* method.

5.4 Correlation analysis

Correlation indicates the strength and direction of a linear relationship between two variables. It is good practice to produce a correlation matrix that contains the correlation between each variable considered in the analysis.

The analysis of the correlation matrix will often reveal why a variable that appeared to have considerable explanatory power (as revealed by the univariate analysis) was not selected by the backward procedure. If two (or more) variables are extremely highly correlated in fact, it is unlikely that they all end up in the final model. If there are reasons to prefer one of the excluded variables it is possible to run again the regression analysis removing one or more variables correlated to it (this is somewhat a trial and error procedure).

Correlation analysis is also necessary to make sure that all the variables that enter the model are uncorrelated so as to grant parameters statistical robustness. Although, as explained above, the backward procedure results generally in a model that does not include variables with a high degree of correlation, a visual inspection of the correlation matrix is still necessary ensure that this is the case (correlation is more common in behavior and collection models). In analyzing the correlation matrix, values higher than 0.6-0.7 can be considered as indicating a significant correlation between two variables.

Regression is a repetitive process that will take place until the input variables will be retained in the model and there will be no exclusions. Validation of individual parameters will be done using Wald Test.

Logical trend – even if a variable has a significant power, I need to follow if the output is logic. If the analysis was properly performed, the model should be predictive and mathematically correct. Obviously Weight of Evidence should follow a linear upward trend and the results (weights or estimated regression parameters) obtained for each interval will be constructed to have a similar logic. The lower class will get the lowest score.

A particular attention should be given to the sign of coefficients. For example, ignoring the rest of variable, if GB odds is subunit then the logarithm of the odds is negative and I expect that the sign of estimated regression intercept is negative.

5.5 Validation of the model

To provide a high level review of the model performance, you should examine the score distribution, then the Good/Bad odds and bad rate by score-band in order to ensure the model displays the expected performance. All shifts and problems should be investigated.

The discriminatory power of a model is a measure of its ability to forecast whether a borrower will default or not (ex-ante). This discriminatory power can be assessed using a number of statistical measures of discrimination such as the Kolmogorov-Smirnov (KS) statistic or Gini coefficient.

The KS statistic is used to assess the model performance by measuring the maximum divergence between cumulative goods and cumulative bads at each score or score-band.

Another tool used to assess model performance is the efficiency curve or ROC (Receiver Operating Characteristic) curve. The ROC chart is used to assess the predictive power of the scorecard across all score ranges by looking at actual discrimination compared to perfect discrimination. The Gini coefficient is the area under the ROC curve (measured as a percentage). The higher the Gini the stronger is the discrimination of the scorecard. A scorecard with no discrimination would have a Gini of zero; a perfect scorecard would have a Gini of 100%.

The KS and Gini measures can be assessed according to the following broad guidelines for application and behavior scorecards.

Table 4. Guidelines for KS and Gini Index

Power of discrimination	Kolmogorov-Smirnov statistic	Gini Index
Low	<30%	<40%
Medium	30% to 45%	40% to 55%
High	> 45%	> 55%

These values must be considered similar to the validation sample, after its calculation with the parameters obtained from the regression model on development data.

5.6 The case study: statistic summary

Construction of the sample: the sample used in the model was chosen randomly, with the 1,000 respondents aged between 14 and 40 years old.

Description of significant variables: in the preliminary analysis I excluded the correlated variables and I kept those with higher Information Value. These variables are described in the "Definition" column from the next table. Easier to use in the process modeling, I have renamed them as described in the column "Name":

Table 5. The list of significant variables

Name	**Type**	**Statistical Type**	**Definition**
V1	Numeric	Metric	Knowledge volume/year on the platform
V2	Numeric	Metric	How many levels of training do you consider necessary the classification of learning objects (i.e. beginner/medium/advanced) ?
V3	Numeric	Metric	How many seconds is reasonable to download a page even if a large number of users are simultaneously connected to the platform ?
V4	Numeric	Metric	During your teaching/learning activity how many hours/day do you use additional resources of information and internet ?
V5	Numeric	Metric	Age
V6	Numeric	Metric	The number of minutes/day using the platform
V7	Numeric	Metric	How many international languages do you consider necessary to use the platform ?
V8	Numeric	Metric	Year of study
V9	Character	Categorical	Do you consider necessary that each user to receive a certain educational material depending on his learning style ?
V10	Character	Categorical	Using an e-learning platform, do you consider necessary to communicate with the teacher and/or other users (i.e. email, forum, chat, blog, etc.) ?
V11	Character	Categorical	Education
V12	Character	Categorical	Gender
V13	Character	Categorical	Do you consider that the evaluation feedback has to be very detailed (i.e. explanation of incorrect answers, highlighting the correct answers, scoring procedures, indicating pages and sections that need to be reviewed, recommending additional materials for a better understanding of concepts/terms) ?
V14	Character	Categorical	Using an e-learning platform, do you consider necessary to rank the educational materials (i.e. module/course/chapter) ?
V15	Character	Categorical	Discipline of study
V16	Character	Categorical	Do you consider the user's feedback important for the evaluation of an e-learning platforms ?
V17	Character	Categorical	Do you need to import/export learning objects in SCORM format/IMS Content Packaging or another format ?

Table 6. Variables selection

Item	p-value	Gini Index	Reason of keeping/ exclusion
V1	<.0001	0.077326	No additional information
V2	0.0003	0.069313	No additional information
V3	<.0001	0.193399	OK
V4	<.0001	0.062570	No additional information
V5	<.0001	0.267938	OK
V6	<.0001	0.296177	OK
V7	<.0001	0.165067	No additional information
V8	<.0001	0.165067	No additional information
V9	<.0001	0.157940	OK

Item	p-value	Gini Index	Reason of keeping/ exclusion
V10	0.0016	0.014364	Wanted it in the model
V11	<.0001	0.225854	OK
V12	<.0001	0.104672	No additional information
V13	<.0001	0.194533	OK
V14	<.0001	0.255882	OK
V15	<.0001	0.208275	No additional information
V16	<.0001	0.186937	No additional information
V17	<.0001	0.270209	No additional information

After data processing, the following variables were considered representative:

Table 7. Representative variables

Name	KS statistic	p-value
V3	0.11531	<.0001
V5	0.23054	<.0001
V6	0.27714	<.0001
V9	0.36836	<.0001
V10	0.01564	0.9999
V11	0.05844	0.0990
V13	0.19628	<.0001
V14	0.14059	<.0001

Correlation analysis: For correlation analysis I considered WoE/group. I preferred Spearman correlation coefficient (rank) because it provides robust results for this outlier in the data.

Table 8. Correlation analysis

		1	2	3	4	5	6	7	8
WOE_V3	1	1.00	0.01	0.07	0.10	-0.02	0.15	0.14	0.05
WOE_V5	2	0.01	1.00	0.39	0.16	-0.01	-0.00	0.14	0.62
WOE_V6	3	0.07	0.39	1.00	0.14	0.05	0.11	0.28	0.33
WOE_V9	4	0.10	0.16	0.14	1.00	0.03	0.07	0.05	0.17
WOE_V10	5	-0.02	-0.01	0.05	0.03	1.00	-0.19	0.02	0.03
WOE_V11	6	0.15	-0.00	0.11	0.07	-0.19	1.00	0.10	0.02
WOE_V13	7	0.14	0.14	0.28	0.05	0.02	0.10	1.00	0.01
WOE_V14	8	0.05	0.62	0.33	0.17	0.03	0.02	0.01	1.00

Next, I will present only the results for variable V13 = Feedback, to observe the logical trend for BR (Bad Rate) and WoE.

Table 9. Results for V13

Item	**V13**
Definition	Do you consider that the evaluation feedback has to be very detailed ?
Transformation	WOE
Information value	0.06

Table 10. BR and WoE for V13

Group	Grouping	#Bad	#Good	Total	BR	WOE
1	A,B	50	100	150	33%	-0.30458
2	C,D	33	91	124	27%	0.016621
3	E,F,G,H	14	40	54	26%	0.052091
4	I	35	127	162	22%	0.291108

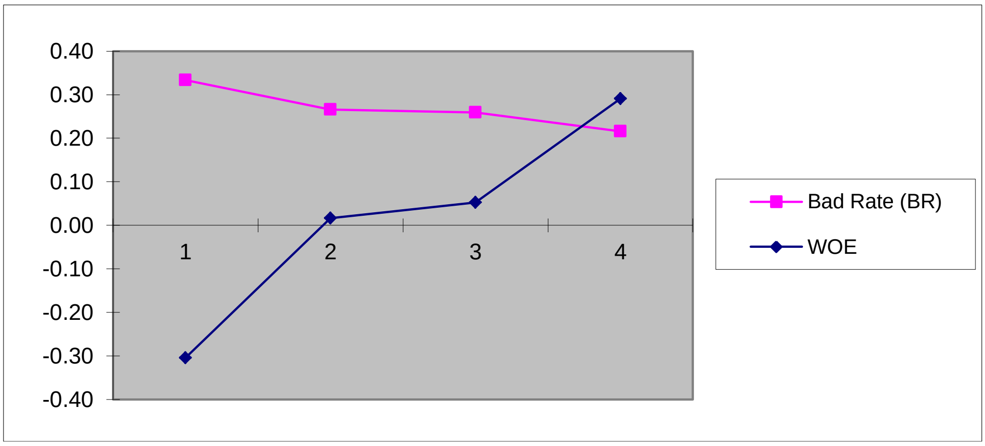

Fig. 2. Logical trend for BR and WoE for V13

Logical trend: WoE, built for each group, has a linear upward trend, from the weakest to the most valuable group, while BR has a downward trend.

6 Conclusions

In order to accurately evaluate the possibilities of an e-learning platform, it is important to pay attention to the Learning Management System (LMS) and the Learning Objects (LO). These two components have to meet certain quality criteria based on e-learning standards. An efficient e-learning system must be able to meet these quality criteria. Of course that with the development of new standards, quality criteria list should be updated. The proposed mathematical model determine the probability that a student uses an e-learning platform based on the factors that determine the quality of the platform (the time to download a page even if a large number of users are simultaneously connected to the platform, tools for communication with the teacher and/or other users, adapting educational material to each user's learning style, hierarchy of the educational materials and the complexity of the evaluation feedback) and the socio-demographic variables of the student (education, age, the average time a student uses a platform).

This model may be used in two different situations, as follows:

Case 1: To evaluate two different e-learning platforms (platform A and platform B) for students with the same profile. It establishes a student profile (i.e. students aged 20 using a platform an average of 30 minutes/day for their learning activity) and characteristics of two different platforms (the time to download a page even if a large number of users are simultaneously connected to the platform, tools for communication with the teacher and/or other users, adapting educational material to each user's learning style, hierarchy of the educational materials and the complexity of the evaluation feedback). Using the regression model I determine the probability that the students use the platform A and the probability that the students use the platform B. The platform

that will achieve the greatest probability, is more appropriate for this student profile.
Case 2: In this situation one platform is evaluated for different student profile (i.e. high school graduates aged 19 using a platform 30 minutes/day and PhD aged 30 using a platform 30 minutes/day). In this case the characteristics of the platform (the time to download a page even if a large number of users are simultaneously connected to the platform, tools for communication with the teacher and/or other users, adapting educational material to each user's learning style, hierarchy of the educational materials and the complexity of the evaluation feedback) are the same but the student profile is different. Using the regression model I determine the probability that each student uses the platform. If the determined probability is higher for PhD student then the platform is more useful for this student profile.

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