# The learning officer decision matrix – a structural equation modeling approach for the management of asynchronous e-Learning projects

**Nuno Pena,** UnYLeYa Portugal and ISEG - School of Economics and Management, University of Lisbon, Portugal, npena@unyleya.com

## Abstract

*Effectiveness is one of the major concerns in corporate e-Learning and is critical when projects face financial and time-to-market constraints. Organizations and corporate universities seek methodologies and tools to help them manage more efficiently diverse e-Learning Projects. This paper describes the outcome of a case study on the assessment of the effectiveness of an e-Learning project (n =1317), from sixteen different corporations in the context of insurance and banking industry in Portugal. Results will be presented on the application of the methodology proposed by Levy for the assessment of the effectiveness of e-Learning systems. Based on the output of this assessment, this paper will present a new tool, the Learning Officer Decision Matrix, which will contribute to a more efficient management of corporate e-Learning projects.*

**Keywords:** e-Learning, effectiveness, quality, asynchronous, Partial Least Squares.

## Introduction

The concept of e-Learning is subject to constant change. An inclusive definition describes *e-Learning* as "an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction and that facilitate the adoption of new ways of understanding and developing learning" (Sangrà, Vlachopoulos, & Cabrera, 2012).

In order to better delimit this wide-ranging concept, Negash and Wilcox (2008) proposed six types of e-Learning classifications: (1) e-Learning with physical presence and without e-communication (face-to-face), (2) e-Learning without presence and without e-communication (self-learning), (3) e- Learning without presence and with e-communication (asynchronous), (4) e-Learning with virtual presence and with e-communication (synchronous), (5) e-Learning with occasional presence and with e-communication (blended/hybrid-asynchronous), and (6) e-Learning with presence and with e-communication (blended/hybrid-synchronous).

E-Learning classifications can aid researchers in identifying learning effectiveness for specific formats and how it alters the student learning experience. In this paper the e-Learning classification used blends self-learning content (type 2), asynchronous communication with tutors and peers (type 3) and a face-to-face final examination (type 5). Throughout the paper, this typology will be generally nominated as 'asynchronous e-Learning'.

## Purpose of the Study and methodology

The main objectives of this paper are (1) to assess the effectiveness of an e-Learning project, more specifically, an asynchronous e-Learning project, (2) to determine and manage quality improvement measures of an asynchronous e-Learning project, and (3) based on the output of the previously stated objectives, to conceive a managerial instrument, a highly practical and accurate tool that can contribute to a more efficient management of corporate e-Learning projects. Consistent with its objectives, this paper is organized in the following manner. First, a case study on the assessment of the effectiveness of an e-Learning project (n =1317), from 16 different corporations in the context of insurance and banking industry in Portugal will be presented. Secondly, the results from this assessment of effectiveness, through the use of an online questionnaire, will be presented and analyzed based on the application of the methodology proposed by Levy (missing year of publication) for the assessment of the effectiveness of e-Learning systems. Since the original model was adapted for asynchronous e-Learning, a new model was restructured based on three dimensions and 41 characteristics. Next, in order to test this new model, author resorted firstly to exploratory factor analysis through Principle Component Analysis (PCA) and subsequent to the structured equation model (Partial Least Squares methodology). Finally, based on the output of these methodologic procedures, a new tool was conceived, a Learning Officer Decision Matrix, which will contribute to a more efficient management of corporate e-Learning Projects. The conclusions and recommendations round out the paper.

## Assessment of effectiveness

An e-Learning project (Insurance Broker Training Program Certifications – General, Life, Non-life and Reinsurance) was developed based on IPTEACES e-Learning framework (Pena, & Isaias, 2012; 2013). IPTEACES (acronym for *I*nvolvement, *P*reparation, *T*ransmission, *E*xemplification, *A*pplication, *C*onnection, *E*valuation and *S*imulation) is an e-Learning Framework conceived to facilitate e-Learning by reducing diversity in programs facing a non-homogeneous audience. This instructional design framework was primarily developed through a pedagogical benchmark, mainly the Nine Events of Instruction (Gagne, Briggs, & Wager, 1992), Merrill (2002; 2007)'s Principles of Learning, Keller (2008)'s ARCS's model, and van Merrienboer's et al (2005), Ten Steps to Complex Learning (van Merriënboer & Kirschner, 2012), the investigating award winning e-courses (e.g. Brandon Hall Excellence in Learning Awards, International eLearning Association Awards), and Bersin & Associates' corporate E-Learning best practices.

This e-Learning Project (Insurance Broker Training Program Certifications – General, Life, Non-life and Reinsurance), targeting 3,726 employees from sixteen different corporations associated with insurance and banking industry in Portugal, accomplished results that fulfill the traditional main objectives of pedagogical efficacy: high approval rate, low dropout rate and high level of satisfaction from the students. This presents a brief characterization of student's demographic indicators as well as a brief characterization of the success indicators:

Table 1: Characterization of student's demographic indicators

| Industry: | 1,614 learners (43,3%) came from the insurance industry and 2112 learners (56,7%) from the banking industry. |
|---|---|
| Gender: | 1,953 male learners (52,4%) and 1,773 female learners (47,6%). |
| Age groups: | Average of 34 years old, with a standard deviation of 8.8 years. Learners range from 18 years old to 71 years old. The distribution was higher in the age category between '24 and 34' years old. |
| Academic Qualifications: | Secondary education 1,607 (43,1%); Undergraduate degree 1,447 (38,8%) and 522 with Primary Education (14,0%). |
| Residency: | Residence shows a high variability; learners came from 18 regions of the Portuguese territory (majority of main cities) |

Among the 3,726 learners who attended the Insurance Broker Training Program certifications e-courses, 3,542 passed the course (approbation rate of 95.0%), and 184 failed (failure rate of 4.9%). More precisely, concerning the three exam sessions, 3,100 learners (83,2%) were approved the first time they took the exam, 382 learners were approved on the second exam session (10,2%), and finally 60 learners on the third exam session (1,6%). The global average score of the learners was 82.5%, with a standard deviation of 11.0.

Among the 3,526 learners, 1,770 learners answered the survey of evaluation of satisfaction, obtaining a response rate of 50.2%. The analysis of the answers showed that, generally, the learners were satisfied or very satisfied with the courses, ranking their answers over 3 on a 4 point Likert scale. An overwhelming majority (76.9%) of the students did not have a previous e-Learning experience in a professional context.

This project produced results that are considered to fulfill the traditional main pedagogical objectives of a corporate e-Learning project. In the quest for effectiveness, the author searched to identify an international benchmark that could help identify the actual effectiveness of this e-Learning project and fundamentally to help recognize items for quality improvement. In the context of the assessment of e-Learning System's effectiveness, Levy (2006) as well as Levy, Murph, & Zanakisy 2009) developed an investigation by querying students concerning the characteristics of e-Learning systems that they value and consider important during their learning experience. This author states that it is not the number of satisfied students or the level of satisfaction that suggest the system's effectiveness - it is the extent in which students are more *satisfied* with the system performance with what they perceive as *important*.

Levy (2006) as well as Levy et al. (2009) proposed a set of characteristics that learners found important, or value, when using e-Learning systems. The list of e-Learning system characteristics was built primarily from an exhaustive review of literature and subsequently through exploratory focus groups, as well as in a qualitative questionnaire. Levy (2006) developed an assessment of such characteristics using a survey instrument. The proposed survey

instrument item scales ranged from (1) very unsatisfied to (6), extremely satisfied and (1) not important to (6) extremely important. Levy proposed 48 e-Learning System characteristics, grouped according to the four dimensions proposed by Webster and Hackley (1997)'s technology and support (14 characteristics), course (12 characteristics), professor (7 characteristics), and learner's dimension (15 characteristics).

In order to determine the level of effectiveness of the Insurance Broker Training e-Learning project, the author applied Levy's proposed methodology. Due to the specificity of this e-Learning project (asynchronous e-Learning), the Professor dimension was withdrawn (therefore seven characteristics directly linked with this dimension), leaving three dimensions and respectively 41 system characteristics – Dimension A "Technology and Support; Dimension B "Course" and Dimension D "Student" - ( cf. Appendix A).

Levy (2006) as well as Levy et al. (2009) proposed two benchmark tools based on the outputs of the questionnaire that can be complemented: "the Value-Satisfaction grid" and "LeVIS index". The objective of "Value-Satisfaction grid" is to provide an indication of action and improvement priorities for the e-Learning system dimension and the e-Learning system characteristics. The "Value-Satisfaction grid" was based on aggregated student perceived satisfaction as well as aggregated student-perceived value of e-Learning system characteristics. In this study the measures scale ranges from 1 to 6, while no scores were noted below 3 in satisfaction and below 3 in value, resulting in the use of 4.5 as the cutoff point between low and high on both axes of the grid.
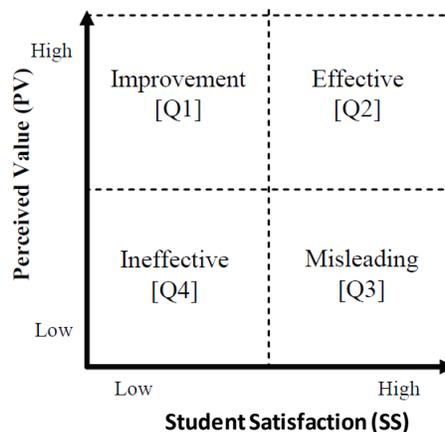


Figure 1: The Value-Satisfaction grid (Levy, 2006; Levy et al., 2009)

The "Value-Satisfaction grid" does not provide however a measure of the magnitude of e-Learning system effectiveness and therefore should be complemented with another tool. The "LeVIS index" proposed by Levy (2006) provides that measure as an overall index of learners' perceived effectiveness of e-Learning systems by combining e-Learning system value measures and e-Learning systems satisfaction measures. "LeVIS index" is proposed as a benchmarking tool combining the learners' perceived value and satisfaction in order to indicate learners' perceived e-Learning system's effectiveness.

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The "Value-Satisfaction grid" suggests that it is not sufficient that only value or only satisfaction measures are high, rather the combination of both value and satisfaction. Consequently, the "LeVIS index" was proposed by Levy as the multiplication of the overall satisfaction ($S\circ$) by the overall value ($V\circ$). "LeVIS index" provides a score of the overall magnitude of the effectiveness of the e-Learning system under study. The magnitude of LeVIS provides that when LeVIS is near 0, this indicates very low learners' perceived e-Learning system's effectiveness. When LeVIS is near 1, this indicates very high learners' perceived e-Learning system's effectiveness. This measure provides that if only one of the two measures ($S\circ$ or $V\circ$) is high, the overall system measure (LeVIS) score is not high. As noted by Levy, an observed limitation of LeVIS is due to the equal importance given for value and satisfaction.

## Assessing the effectiveness of the Insurance Broker e-Learning Project

Due to corporate policies and constraints, the application of the adapted version of the online questionnaire targeted only 2,531 students of the original 3,726 students. The response rate was 52.03%, i.e., 1,317 trainees. More specifically, 59.6% of respondents were from the banking industry, 40.4% were from the insurance industry.Results from Overall Value-Satisfaction Grid are presented below:
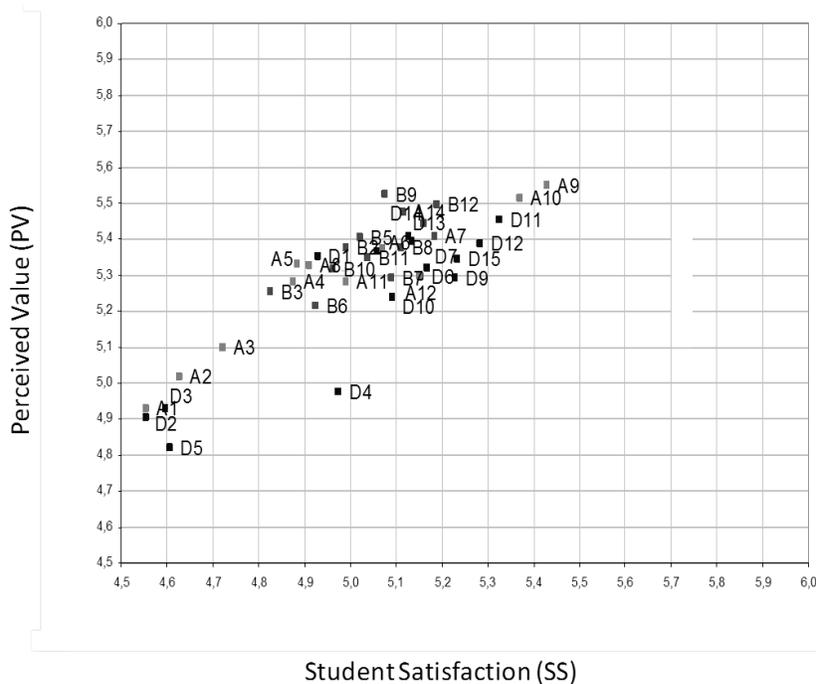


Figure 2 – Overall Value-Satisfaction Grid (all dimensions)

The Overall Value-Satisfaction Grid shows that all the 41 e-Learning system characteristics are situated in the in the 'Effective Quadrant'. All the characteristics and dimensions are considered *effective*. Having 'excellence' as orientation, as it can be seen in this overall grid, there are seven e-Learning System Characteristics that are somehow separate from the other 34 (less effective).

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These seven e-Learning system characteristics positioned on the lower corner of the quadrant somehow represent that there are two groups (or sub-categories) that should be considered to have priority in terms of quality improvement: *HelpDesk* (A1, A2 and A3) originally corresponding to "Dimension A - Technology and Support" and *Class* (D3, D2, D4 and D5) originally corresponding to "Dimension D – Learner" - (cf. Appendix A).

Results from the Global LeVIS index indicate (see Figure 3) that the overall e-Learning system under study reached a global LeVIS score of 0.781 and therefore should be classified as "High Effectiveness". All the dimensions are above 0.75 global scores and therefore can be considered as having *High Effectiveness*, (Dimension A – 0.757; Dimension B – 0.767, Dimension D – 0.758), with a particular emphasis on *Dimension B – Course* which had the highest score of all dimensions.
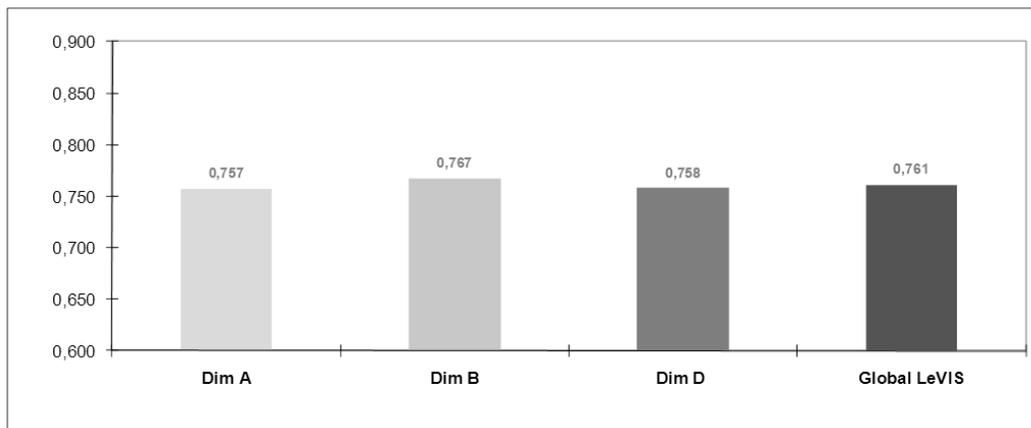


Figure 3 – LeVIS index (all dimensions)

## Testing the adapted Model

Based on the outputs of Overall Value-Satisfaction Grid, the author felt the need to review the new model based on three dimensions (adapted for asynchronous e-Learning) and to reanalyze their correspondent attributes (41 characteristics). In order to design and test the new model, the author used firstly exploratory factor analysis through Principle Component Analysis and subsequently structured equation model (Partial Least Squares methodology).

To perform the Exploratory Factor Analysis the author resorted to Principle Component Analysis (PCA) – (n=1317) with Varimax Rotation and Kaiser Normalization.

Table 2: Bartlett's sphericity test and Kaiser-Meyer-Olkin measure of sampling adequacy

| Kaiser-Meyer-Olkin measure of sampling adequacy. | | .980 |
|---|---|---|
| Bartlett's test of sphericity | Chi - Square | 32250,824 |
| | Degrees of Freedom | 820 |
| | Evidential value | .000 |

Table 3, below, presents commonalities and the total explained variance.

Table 3: Presentation of Factors - Rotation Method: Varimax with Kaiser Normalization.

|  | Extraction |  | Extraction |  | Extraction |  | Extraction |  | Extraction |  | Extraction |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B1 | ,797 | B8 | ,796 | A5 | ,667 | A12 | ,754 | D10 | ,707 | D3 | ,912 |
| B2 | ,824 | B9 | ,819 | A6 | ,720 | A13 | ,762 | D11 | ,726 | D4 | ,873 |
| B3 | ,789 | B10 | ,817 | A7 | ,725 | A14 | ,689 | D12 | ,794 | D5 | ,866 |
| B4 | ,780 | B11 | ,828 | A8 | ,699 | D6 | ,775 | D13 | ,733 | A1 | ,862 |
| B5 | ,816 | B12 | ,730 | A9 | ,802 | D7 | ,780 | D14 | ,797 | A2 | ,871 |
| B6 | ,790 | D1 | ,742 | A10 | ,826 | D8 | ,722 | D15 | ,719 | A3 | ,824 |
| B7 | ,839 | A4 | ,700 | A11 | ,752 | D9 | ,682 | D2 | ,908 |  |  |

The saturations of the variables in each factor have been always above the required minimum of 40%, which is confirmed by the following structure of five factors:

- Factor 1 – *Course Contents*: This factor is related to the availability and quality of the content of the course and includes 13 items ($\alpha = 0.977$);
- Factor 2 - *Accessibility / Asynchronous*: This factor includes 11 items related to accessibility and operability of access to the course ($\alpha = 0.957$). The variable A4 (System operation time (up-time)), included in this factor, is slightly more associated with Factor 5, however, due to the similarity of values and theoretical relevance, the author chooses to keep this variable associated factor 2.
- Factor 3 - *Perceived Value*: The third factor includes 10 items ($\alpha = 0.959$), which are related to perceived value in the possibility of reconciling the course with daily and professional activities as well as extra-professional activities.
- Factor 4 - *Class*: The class factor includes four items related to peer interaction in training ($\alpha = 0.962$).
- Factor 5 - *Helpdesk*: This factor includes three items of response, related to quality and support provided by the helpdesk ($\alpha = 0.939$).
- Grouping Factor - There is, therefore, an appropriate grouping factor. The internal consistency analysis produced results that allow verifying the suitability of the factors identified. The Cronbach's alpha ($\alpha$) had values well above 0.7, which indicate a high internal consistency. In factor 2, the Cronbach's alpha ($\alpha$) of 0.957 also allows supporting the decision to keep the item "A4" associated with this factor, since its elimination would result in a lower level of consistency factor (0.957 to 0.954).

## Structural Equation Modeling

In a second stage, in order to test the relationship between the five identified factors - Course Content, Accessibility / Asynchronous, Perceived Value, Class and Helpdesk - and the central

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variable in the study - Global LeVIS – the author resorted to Structural Equation Model, more specifically, to Partial Least Squares (PLS) methodology. "Educational researchers frequently work in a situation with massive amounts of data, but the relative scarcity of theoretical knowledge. In such a problem area, partial least squares (PLS) path analysis with latent constructs is a useful and flexible tool for statistical model building. The use of PLS may be considered especially when the research situation at hand demands the investigation of complex models in an exploratory rather than a confirmatory fashion" (Sellim, 1995).
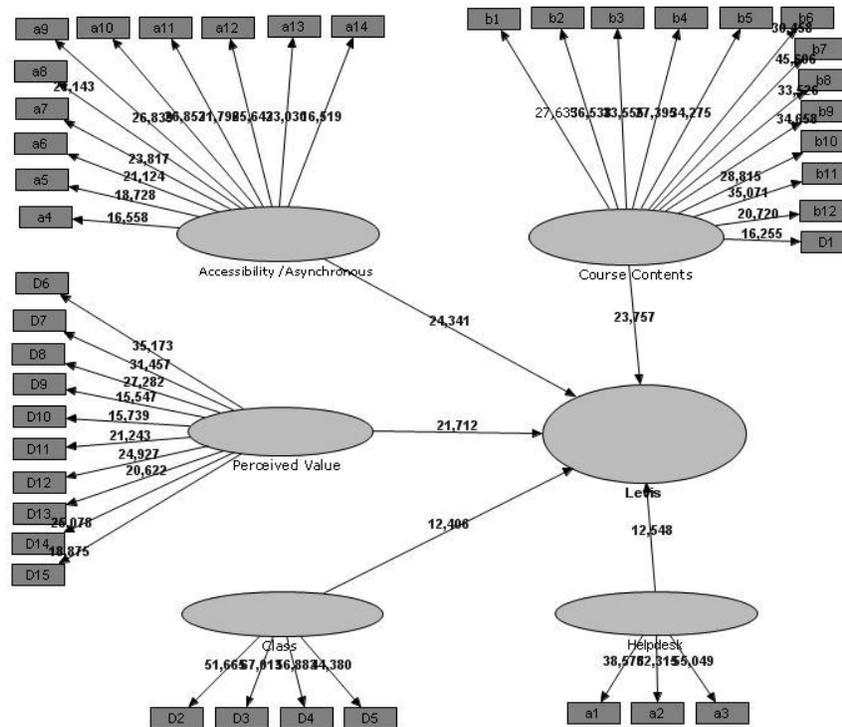


Figure 4: Partial Least Squares - Values of T for the correlations

Table 4: Synthesis of Global data model quality (PLS)

|  | Average variance extracted | Composite Reliability | Cronbach's Alpha | Commonality | Redundancy |
|---|---|---|---|---|---|
| Levis | 0,5938 | 0,9835 | 0,9826 | 0,5938 | 0,2527 |
| Accessibility /Asynchronous | 0,6868 | 0,9602 | 0,9543 | 0,6868 | 0,0000 |
| Course Contents | 0,7681 | 0,9773 | 0,9747 | 0,7681 | 0,0000 |
| Helpdesk | 0,8856 | 0,9587 | 0,9355 | 0,8856 | 0,0000 |
| Class | 0,9003 | 0,9731 | 0,9631 | 0,9003 | 0,0000 |
| Perceived Value | 0,7166 | 0,9619 | 0,9559 | 0,7166 | 0,0000 |

The average extracted variance for each factor exceeds the minimum required value of 0.50 (Fornell & Bookstein, 1981). In this case, all values from the Internal Consistency Composite exceed 0.96. The model based on five proposed factors - Course Content, Accessibility / Asynchronous, Perceived Value, Class and Helpdesk - was totally confirmed. Appendix B presents detailed results from the PLS model.

## Chief Learning Officers' Decision Matrix

In the quest for "excellence" and in order to support a systematic program of actions to be implemented in line with a continuous quality improvement, the author performed the identification of indicators, which represent priorities' to act on. In order to conceive a new tool which could contribute to a more efficient management of corporate e-Learning Projects, author developed the "Learning Officer Decision Matrix" (LODM). LODM has as input the data produced by LeVIS index as well as the data resulting from Partial Least Squares, based on the new model of three dimensions and their correspondent attributes (specially adapted for asynchronous e-Learning).

Below are descriptions of concepts used in the following tables:

Concepts:

- Factors Standardized Weights – standardized output of PLS Path Coefficients, specifically "Original Sample";
- Items Standardized Weights – standardized output of PLS Outer Weights;
- LeVIS – Score from students (Standardized (satisfy * important));
- Excellence = 1 (i.e., 100%);
- Market Deviation = Excellence – LeVIS score;
- Competitive Deviation = Market Deviation * Standardized Weights;
- Effort = Standardized Competitive Deviation;
- Priorities = Ranking of Effort.

Based on the outputs resultant from Structural Equation Modeling through PLS, table 5 below presents the ranking of the five dimensions priorities for quality improvement intervention, i.e., the factors (dimensions) which can contribute more to raise Global LeVIS score.

Table 5 – Dimension improvement ranking

| Factors | Standardized Weight | LeVIS | Excellence | Market Deviation | Competitive Deviation | Effort | Priorities |
|---|---|---|---|---|---|---|---|
| F1 - Course Contents | 35% | 0,728799 | 1 | 0,271201000 | 0,081540929 | 30% | 1 |
| F2 - Accessibility /Asynchronous | 25% | 0,752995 | 1 | 0,247005167 | 0,061692537 | 23% | 2 |
| F3 - Perceived Value | 24% | 0,778063 | 1 | 0,221936535 | 0,054692257 | 20% | 3 |
| F4 - Class | 10% | 0,654201 | 1 | 0,345798722 | 0,043265968 | 16% | 4 |
| F5 -Helpdesk | 7% | 0,643885 | 1 | 0,356114887 | 0,027784416 | 10% | 5 |

The factor 1 – "Course Contents" emerges as the first priority factor for action improvement, which should be invested an effort of 35% to improve effectiveness, i.e., to improve Global LevIS. The second factor "Accessibility / Asynchronous" emerges as second priority to invest, where the effort should be about 25%, while the third factor "Perceived Value" is the third priority of intervention that requires an effort of 24%. Factors "Class" and "Helpdesk" are the 4th and 5th priority, which should focus respectively 10% and 7% of intervention efforts at the level of measures to improve global LeVIS.

As the next step and in order to identify more detail priorities for action improvement, specifically with regard to each item (characteristic) belonging to each factor (dimension), the author performed the analysis of the priorities of every single indicator/characteristic (cf. Appendix A).

Data presented in Table 6 reveals that the first priorities for action improvement relate to the three items linked to "class", in which item D5 "Being part of a 'class' although it was online" should be the first priority intervention, representing 3.53% of the improvement efforts. D2 "Amount of interaction with classmates" and D3 -" Quality of interaction with classmates ", appear as the second and third priority, requiring respectively 3.39% and 3.33% of the intervention efforts.

Data also shows that item A1 - "Quick answer from technical support (HelpDesk) via phone", performance-related to the helpdesk, is the fourth priority for action, representing an effort of 3.19%. After the fifth priority item D4 - "Classmates' attitude (across all courses)" which is again related to Class Dimension, requires 3.17% of intervention efforts of improvement actions. Subsequently, items A2 - " Quick answer from technical support (Help Desk) after-hours via e-mail" and A3 " Quality of technical support (Help Desk)", again related to the Helpdesk Dimension, represent, respectively the 6th and 7th priority, which should be invested 3.17% and 3.10% of the effort.

One possible reason for the improvement of these items related to "Class" is that, despite being an asynchronous e-Learning project, the use of the asynchronous collaboration tools (especially non moderated peer discussion forums) were throughout the course voluntary and non-mandatory - therefore these tools were insufficiently promoted and a significant amount of students did not use them or eventually had difficulties in their use. In this sense, it should be developed strategies to promote even more peer communication (students-students) and produced different mechanisms that can facilitate students to use these e-Learning tools. In terms of items concerning Dimension "HelpDesk", it should be implemented a strategy in order to gain a superior level of satisfaction from the students concerning HelpDesk services by increasing, for example, the Helpdesk SLA's (service level agreements). Items B6 – "Availability of other content (syllabus, objectives, assignments, schedule)", and B3 – "Amount of material in courses"

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and B10 – "Gathering information quickly" are respectively the 8th, 9th and 10th priorities where intervention efforts should be 3.05%, 2.94% and 2.77% respectively.

Table 6 – Improvement ranking for all items

| Itens | Standardized Weight | LeVIS | Excellence | Market Deviation | Competitive Deviation | Effort | Priorities |
|---|---|---|---|---|---|---|---|
| a3 | 2,4% | 0,679870075 | 1 | 0,32012992 | 0,007731562 | 3,10% | 7 |
| a2 | 2,3% | 0,655888805 | 1 | 0,3441112 | 0,007904686 | 3,17% | 6 |
| a1 | 2,2% | 0,634480722 | 1 | 0,36551928 | 0,007960401 | 3,19% | 4 |
| d5 | 2,4% | 0,636948452 | 1 | 0,36305155 | 0,008805863 | 3,53% | 1 |
| d4 | 2,4% | 0,669640597 | 1 | 0,3303594 | 0,007905395 | 3,17% | 5 |
| d3 | 2,4% | 0,648443432 | 1 | 0,35155657 | 0,008314113 | 3,33% | 3 |
| d2 | 2,3% | 0,638994347 | 1 | 0,36100565 | 0,008465779 | 3,39% | 2 |
| d7 | 2,6% | 0,777587952 | 1 | 0,22241205 | 0,005828688 | 2,33% | 25 |
| d8 | 2,6% | 0,766156247 | 1 | 0,23384375 | 0,005972351 | 2,39% | 22 |
| d6 | 2,6% | 0,771450266 | 1 | 0,22854973 | 0,006003390 | 2,40% | 20 |
| d10 | 2,2% | 0,755800219 | 1 | 0,24419978 | 0,005393093 | 2,16% | 28 |
| d9 | 2,2% | 0,783746731 | 1 | 0,21625327 | 0,004710358 | 1,89% | 34 |
| d15 | 2,3% | 0,791487387 | 1 | 0,20851261 | 0,004710279 | 1,89% | 35 |
| d13 | 2,3% | 0,782270311 | 1 | 0,21772969 | 0,005028476 | 2,01% | 31 |
| d11 | 2,3% | 0,820235383 | 1 | 0,17976462 | 0,004158936 | 1,67% | 39 |
| d12 | 2,4% | 0,805323547 | 1 | 0,19467645 | 0,004692739 | 1,88% | 37 |
| d14 | 2,4% | 0,783113980 | 1 | 0,216886020 | 0,005105402 | 2,04% | 30 |
| a4 | 2,1% | 0,725491437 | 1 | 0,27450856 | 0,005883099 | 2,36% | 23 |
| a5 | 2,2% | 0,732135324 | 1 | 0,26786468 | 0,005796017 | 2,32% | 26 |
| a6 | 2,3% | 0,767695942 | 1 | 0,23230406 | 0,005357509 | 2,15% | 29 |
| a8 | 2,3% | 0,737323884 | 1 | 0,26267612 | 0,005998306 | 2,40% | 21 |
| a11 | 2,4% | 0,745022357 | 1 | 0,25497764 | 0,006017294 | 2,41% | 19 |
| a12 | 2,4% | 0,771408082 | 1 | 0,22859192 | 0,005517322 | 2,21% | 27 |
| a14 | 2,2% | 0,787184679 | 1 | 0,21281532 | 0,004644413 | 1,86% | 38 |
| a7 | 2,2% | 0,790074243 | 1 | 0,20992576 | 0,004694044 | 1,88% | 36 |
| a13 | 2,3% | 0,790664811 | 1 | 0,20933519 | 0,004875333 | 1,95% | 33 |
| a9 | 2,2% | 0,847148401 | 1 | 0,1528516 | 0,003373655 | 1,35% | 41 |
| a10 | 2,3% | 0,832784949 | 1 | 0,16721505 | 0,003811513 | 1,53% | 40 |
| b1 | 2,7% | 0,747490087 | 1 | 0,25250991 | 0,006763633 | 2,71% | 11 |
| b12 | 2,5% | 0,802602717 | 1 | 0,19739728 | 0,005022133 | 2,01% | 32 |
| b9 | 2,8% | 0,756601704 | 1 | 0,2433983 | 0,006705421 | 2,69% | 13 |
| d1 | 2,6% | 0,743693580 | 1 | 0,256306420 | 0,006716589 | 2,69% | 12 |
| b8 | 2,7% | 0,775352232 | 1 | 0,22464777 | 0,006079080 | 2,43% | 18 |
| b6 | 2,7% | 0,727094406 | 1 | 0,27290559 | 0,007351620 | 2,94% | 9 |
| b3 | 2,7% | 0,716295453 | 1 | 0,28370455 | 0,007607865 | 3,05% | 8 |
| b10 | 2,7% | 0,746098034 | 1 | 0,25390197 | 0,006917241 | 2,77% | 10 |
| b4 | 2,6% | 0,774234371 | 1 | 0,22576563 | 0,005861095 | 2,35% | 24 |
| b11 | 2,7% | 0,760672404 | 1 | 0,239327596 | 0,006542110 | 2,62% | 16 |
| b5 | 2,7% | 0,764236902 | 1 | 0,235763098 | 0,006307859 | 2,53% | 17 |
| b7 | 2,7% | 0,760503670 | 1 | 0,239496330 | 0,006583296 | 2,64% | 14 |
| b2 | 2,7% | 0,755863494 | 1 | 0,244136506 | 0,006554259 | 2,63% | 15 |

## Conclusion and Further Research Directions

This paper described the outcome of a case study on the assessment of the effectiveness of an e-Learning project (n=1317), in the context of sixteen different corporations in the insurance and banking industry in Portugal. Based on the methodology proposed by Levy (2006; 2009) for the assessment of the effectiveness of e-Learning systems, the author assessed the effectiveness of

this e-Learning project. Results showed that the Global LeVIS of the e-Learning system under study reached a score of 0.781 and therefore should be classified as "highly effective". All of the 41 e-Learning system characteristics were situated in the in the 'Effective Quadrant'. In order to review the new model based on three dimensions (adapted for asynchronous e-Learning) and also to reanalyze their corresponding attributes, the author performed a firstly exploratory factor analysis through Principle Component Analysis and subsequently a structural equation model (Partial Least Squares methodology). Based on the output of these methodology procedures, the author developed a new tool, a *Learning Officer Decision Matrix*, which will contribute to a more efficient management of corporate e-Learning Projects. The Learning Officer Decision Matrix (LODM) produces practical and actionable information for decision making and gives metrics such as "priorities" and "effort" that are more understandable and pragmatic for managers. Managers can replicate the proposed procedure in order to gain more intelligibility on their own projects and mainly to manage more efficiently corporate e-Learning systems and e-Learning projects. More importantly, LODM provides impartial and accurate information that can support managers on how they should apply and distribute adequately their budgets in quality improvement specific areas of their projects and the expected impact that each measures will produce (dimension level and characteristic level).

This study is however limited to a specific e-Learning project, in Portugal, although the number of students under study (n=1317) and Organizations (n=16) is statistically representative. The Learning Officer Decision Matrix (LODM) was developed specifically for asynchronous e-Learning Project, though it can be adapted for other types of e-Learning and/or blended Learning projects. Further research with larger and more diverse typologies of e-Learning projects is required in the future to strengthen the research findings.

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# Appendix A – e-Learning System Characteristics

| | |
|---|---|
| **TECHCNOLOGY AND SUPPORT DIMENSION** | |
| **A1** | Quick answer from technical support via phone |
| **A2** | Quick answer from technical support after-hours via e-mail |
| **A3** | Quality of technical support |
| **A4** | System operation time (up-time) |
| **A5** | Reduced system errors |
| **A6** | System security (discourage hacking, secure access, etc.) |
| **A7** | Access to courses from anywhere in the world (via the Internet) |
| **A8** | High Network availability & Low network congestion |
| **A9** | Learning at any time of the day (schedule flexibility) |
| **A10** | Submit assignments from anywhere (via the Internet) |
| **A11** | Different system tools (chat, bulletin-board or discussion forums, etc.) |
| **A12** | Access of all courses from one area (My LMS) |
| **A13** | Taking quizzes remotely (off-campus) |
| **A14** | Review course materials |
| **COURSE DIMENSION** | |
| **B1** | Availability of course content |
| **B2** | Quality content of courses |
| **B3** | Amount of material in courses |
| **B4** | Interesting subject matter |
| **B5** | Difficulty of subject matter |
| **B6** | Availability of other content (syllabus, objectives, assignments, schedule) |
| **B7** | Enjoyment from the courses/lessons |
| **B8** | Ease-of-use (with course content, navigation, interface, etc.) |
| **B9** | Similar of interface across all online courses |
| **B10** | Gathering information quickly |
| **B11** | Organization of courses (content of courses, organization of assignments, etc. across all course modules) |
| **B12** | Taking practice tests prior to graded test |
| **LEARNER DIMENSION** | |
| **D1** | Learning a lot in these classes |
| **D2** | Amount of interaction with classmates |
| **D3** | Quality of interaction with classmates |

| **D4** | Classmates' attitude (across all courses) |
|--------|-------------------------------------------|
| **D5** | Being part of a 'class' although it was online |
| **D6** | Your comfort with online learning and technology |
| **D7** | Your Internet and computer skills |
| **D8** | Self-discipline and time management |
| **D9** | Cost of courses |
| **D10** | Cost of ISP and Internet access |
| **D11** | Reduced travel cost/time (to and from campus) |
| **D12** | Ability to travel while taking online courses (for business or other) |
| **D13** | Employer support and your ability to work while learning |
| **D14** | Attendance to family responsibilities |
| **D15** | Family support |

## Appendix B - Partial Least Squares: Outer Weights and Path Coefficients

|  | Course Contents | Accessibility/ Asynchronous | Perceived Value | Class | Helpdesk | Levis |
|---|---|---|---|---|---|---|
| b1 | 0,0877 | | | | | 0,0343 |
| b2 | 0,0879 | | | | | 0,0344 |
| b3 | 0,0878 | | | | | 0,0343 |
| b4 | 0,0850 | | | | | 0,0332 |
| b5 | 0,0876 | | | | | 0,0343 |
| b6 | 0,0882 | | | | | 0,0345 |
| b7 | 0,0900 | | | | | 0,0352 |
| b8 | 0,0886 | | | | | 0,0346 |
| b9 | 0,0902 | | | | | 0,0353 |
| b10 | 0,0892 | | | | | 0,0349 |
| b11 | 0,0895 | | | | | 0,0350 |
| b12 | 0,0833 | | | | | 0,0325 |
| D1 | 0,0858 | | | | | 0,0335 |
| a4 | | 0,1038 | | | | 0,0290 |
| a5 | | 0,1048 | | | | 0,0293 |
| a6 | | 0,1117 | | | | 0,0312 |
| a7 | | 0,1083 | | | | 0,0303 |
| a8 | | 0,1106 | | | | 0,0309 |
| a9 | | 0,1069 | | | | 0,0299 |
| a10 | | 0,1104 | | | | 0,0308 |
| a11 | | 0,1143 | | | | 0,0319 |
| a12 | | 0,1169 | | | | 0,0327 |
| a13 | | 0,1128 | | | | 0,0315 |
| a14 | | 0,1057 | | | | 0,0295 |
| D6 | | | 0,1300 | | | 0,0348 |
| D7 | | | 0,1297 | | | 0,0347 |
| D8 | | | 0,1264 | | | 0,0338 |
| D9 | | | 0,1078 | | | 0,0288 |
| D10 | | | 0,1093 | | | 0,0292 |
| D11 | | | 0,1145 | | | 0,0306 |

| | | | | | |
|---|---|---|---|---|---|
| D12 | | | 0,1193 | | 0,0319 |
| D13 | | | 0,1143 | | 0,0306 |
| D14 | | | 0,1165 | | 0,0312 |
| D15 | | | 0,1118 | | 0,0299 |
| D2 | | | | 0,2594 | 0,0277 |
| D3 | | | | 0,2616 | 0,0280 |
| D4 | | | | 0,2647 | 0,0283 |
| D5 | | | | 0,2683 | 0,0287 |
| a1 | | | | 0,3359 | 0,0260 |
| a2 | | | | 0,3543 | 0,0274 |
| a3 | | | | 0,3725 | 0,0288 |

| | Original sample (O) | Sample mean (M) | Standard Deviation (STDEV) | Standard Error (STERR) | Statistical T | p |
|---|---|---|---|---|---|---|
| Accessibility/ Asynchronous -> Levis | 0,2794 | 0,2787 | 0,0115 | 0,0115 | 24,3406 | <0,001 |
| Course Contents -> Levis | 0,3909 | 0,3925 | 0,0165 | 0,0165 | 23,7574 | <0,001 |
| Helpdesk -> Levis | 0,0773 | 0,0761 | 0,0062 | 0,0062 | 12,5478 | <0,001 |
| Class -> Levis | 0,1069 | 0,1075 | 0,0086 | 0,0086 | 12,4063 | <0,001 |
| Perceived Value -> Levis | 0,2674 | 0,2668 | 0,0123 | 0,0123 | 21,7117 | <0,001 |

Path Coefficients – Correlation coefficients between factors and Dimension

## Author's Biography

**Nuno Pena** is a Senior Learning Officer, Director of UnYLeYa (LeYa Group) and Associated Researcher at ADVANCE Research Center of ISEG - School of Economics and Management (Technical University of Lisbon). Nuno finished his Postdoc in the field of Management Information Systems, holds a Ph.D. in Information Management, a Master degree in Multimedia Educational Communication; a Postgraduate certificate in Education (PGCE) and a Bachelor in Philosophy.