# Learning platform assessment model LMS

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**Abstract:** Use and appropriation of a LMS by higher education institutions require a decision that should go beyond economic aspects, especially when there is a mimetic institutionalism in most platforms, which offer similar educational, communication, interaction and management services and tools. In this regard, this article makes a proposal to establish a quantitative evaluation system that assesses attributes of LMS platforms, according to institutional requirements.

**Keywords:** LMS Platform, Virtual Environment Assessment, LMS Metric.

## 1 Introduction

Day by day education has been incorporating new Information and Communication Technologies (ICT) into their training processes, thus raising awareness in world population of knowledge society and directing academic institutions, particularly Higher Education Institutions(HEI), to adopt new teaching methodologies, new teacher and student roles and, therefore, new forms of management and administration in academic processes as well as the creation of various means of dissemination, sharing and interaction of information and knowledge.

Regarding this process of implementing and adopting ICT in HEIs, quality criteria, strategies and standards have been defined [1], which have gradually guaranteed the quality and relevance of this training methodology [2] and the acceptance of this alternative training by the academic community [3].

The development of a virtual learning methodology is subject to a number of factors, such as content production, digital resources, content repositories and creation of learning objects and technology platforms - Learning Management System (LMS), where information is exchanged, resources are delivered and learning process is monitored.

In the context of virtual education platforms, countless options are identified; they have similar characteristics, work as content repositories, contain various materials, and provide tools for both synchronous and asynchronous communication and interaction [4]. Therefore, this is the space where information, teaching experience and students' needs converge, promoting synergy and connectivism among actors in the educational process [5, 6]. In addition, recommendation systems are created to help identify resources or information relevant to the student [7].

Furthermore, studies concerning the assessment of virtual education platforms have conducted from a qualitative perspective, considering aspects such as interactivity, flexibility, scalability, usability, functionality, ubiquity, persuadability [4, 8]. Other studies focused on platform type (proprietary, free, multi-language), installation and administration (course management, profiles, and authentication), communication tools, and type of resources. However, the studies are limited to verifying the existence of such options [8, 9]. Other studies identify and compare the features of platforms [10]; a recent study assesses three platforms considering aspects such as user interface, contents system, and platform customization [11].

In relation to the above, this paper presents a metric to guide the team responsible for evaluation and decision-making in choosing the platform to be implemented in HEIs so that they have objective criteria to do so, using a quantitative methodology for assessing and comparing LMS features and attributes.

## 2 Learning environments

Technology and e-learning platforms are considered a factor contributing to the positioning and success of HEIs, which involves changes in many aspects such as administration, teachers, educational processes and, in particular, teaching-learning and access to knowledge methodologies. Additionally, these virtual environments become a strategy for dissemination, institutional recognition, and coverage.

Regarding these developments, different degrees or levels of virtualization of virtual learning environments are promoted, as defined by how ICTs are implemented. VLEs have evolved in many and varied ways of disseminating and sharing information such as LMS (Learning Management System), m-learning models [12-14], 3D educational environments [15] or metaverses [16, 17], Augmented Reality models [18], Gamification strategies [19] and tutorial videos such as Khan Academy [20]. These offer a wide variety of digital resources that could be reused and shared by institutions through shared virtual campuses [21], federation of repositories [22] and, last but not least, resource recommendation systems [7].

In this sense, the paper presented by Lara and Duart (2005) shows the evolution of online learning, along with the creation of standards that ensure quality and interoperability of existing resources and platforms, where complexity of technological developments are related to the benefits for training [4, 23]. It also proposes the creation of content and resource management models within institutions in order to consolidate and capitalize academic media and materials, which are now available in learning platforms.

Therefore, when selecting the platform (LMS) to be implemented in the HEI, technical, economic, support, usability, accessibility and other aspects should be taken into account, as well as aspects related to the type of project (business, educational, state or social).

As for this environment, there is a number of learning platforms ranging from proprietary to open source applications, including student-, teacher- and learning process-oriented platforms. In many cases, this makes HEIs establish which of the existing platforms responds to the pedagogical and communicative model of the institution. However, the studies conducted compare platforms in terms of resources and tools available [4], hindering decision-making with respect to the best LMS to be implemented in the institution and often leading HEIs to have more than one platform available for the development of their virtual courses, without any objective selection criteria beyond being the most recognized and/or supported LMS.

In addition, it is observed that the decision of which platform is more suitable also responds to the interests of engineers or content designers who, by default, make use of the platforms that have managed to position in the educational environment. Adopting platforms that have already been successful in other educational institutions gives rise to a mimesis and ignores the interests of the institution and community that will use the platform.

## 3 Learning Management System

Learning Management Systems or LMS are programs that administer and manage the teaching-learning process through the integrated use of different tools, either for distance training or as an aid for classroom teaching, and where the student is the protagonist of his/her learning process and has the possibility of joining several knowledge networks [24].

They are online education settings designed to offer remote assistance that allow integration of multimedia material and discussion forums. Virtual platforms are based on four major axes: 1) interaction, which allows to establish communication processes among participants; 2) introspection, which seeks to foster critical and creative thinking through the resources offered; 3) innovation, because alternative learning and assessment processes increase; and, finally, 4) integration of communication, collaborative work and administration tools such as those mentioned above: profiles, email, discussion forums, bulletin boards and multimedia resources (video, audio, image).

For Vazquez (2015), a platform essentially meets three conditions: 1) it is a fully developed environment that allows network access and interaction between students and teachers, 2) it has a set of resources and assessment strategies, and 3) it provides activity management. Additionally, the platform should automate processes and administration and have portability and standards [25]. However, the study conducted by the authors argue that, while LMS offer advantages, they cannot be taken for granted, i.e., it is necessary to consider the risks this implies for the student such as student's beliefs and motivations, assessment to the extent that it does not reflect student's progress, simple and user-friendly applications, isolation, type of activities, among others.

A relevant aspect when considering a platform is its design, which must ensure usability so that the development of content and activities is efficient, effective and satisfactory. For this, a type of user assessment is proposed [26].

The main functions of management systems are management of users, resources, materials and activities, monitoring of the learning process, assessment, reporting, and communication services. However, a new generation of service-oriented platforms [27], with interoperable services among LMS, has been started [28].

These learning management systems have evolved since 1960 with a system developed at the University of Illinois (PLATO - http://www.plato.com/solutions). In 1970, a project developed by IBM in collaboration with the Stanford University introduced "Coursewriter" where user roles such as instructor, administrator and student are defined.

Furthermore, changes and levels of virtuality have evolved hand in hand with the web and ICTs as these has been the means where different applications have been developed for teaching-learning processes. This situation demands the incorporation of new options in the platforms.

Most LMS allow functions such as learning space management, communication of participants, content management, activity management, and evaluation. The study conducted by Salinas (2005) deals with three components related to platform quality: pedagogical, organizational and technical.

LMS have four independent systems with specific features that are integrated to implement information technologies in the educational process. These systems are identified as contents, exams, assessment, and communication tools [29, 30] and have a set of services in place.

Istambul (2016) considers that LMS must be designed to facilitate navigation by students while reviewing contents and carrying out the proposed activities. Thus, LMS should take into account the behavior of students, giving way to individualized learning, i.e. the student learns independently by accessing information. This strengthens self-learning because the student is encouraged to construct knowledge [31] and assigned different levels of activities on the platforms.

For Muñoz-Merino (2009), learning platforms in subsequent generations should be service-oriented, defining the following layers (Table 5): 1) Infrastructure, 2) Services, 3) Educational Services, and 4) Educational Applications [28].

As already defined, platforms and resources must be user-friendly, easy to navigate, motivating and intuitive environments [32], so that students accomplish the learning objectives defined by thematic experts or tutoring teachers and/or content authors.

The following lines present the main technical factors of platforms based on the model established for software development and quality, in accordance with ISO/IEC 9126 for websites, and transposes learning platforms.

- Interactivity: The interaction is measured according to student's motivation for e-learning systems and information available through interaction. LMSs are able to capture many details related to student's participation status and data on interaction with the system [33].
- Accessibility: A necessary condition for LMS platforms and virtual education environments is to enable students to participate, access and use digital resources [34]. For these authors, accessibility should also be present in two ways: 1) in education resources and 2) in the LMS platform, including collaborative services, editing services, complementary software services, which must meet the standards set for the WWW Consortium [35].
- Usability: ISO 9241 and 9126 define usability as the extent to which a product can be used by specified users to achieve specific goals effectively, efficiently and satisfactorily in a context of use [36].
- Flexibility: For Nokelainen (2006), under this perspective the student has the opportunity to explore the learning material freely. Flexibility in learning material content means that the material contains various assignments and defines the social organization of learning (face to face, group, individual) along with the source of learning resources (teacher, student, library, Internet) to be used.
- Scalability: In the development of web applications and particularly LMS Platforms, it means that the number of students can be increased exponentially in a short period of time, which can modify the behavior of the application. Scalability intends that the platform be able to operate independently of the number of registered and active users [37].
- Standardization: Virtual education or e-Learning has grown considerable. Aware of this phenomenon, various organizations and companies related to software and education are working on creating standards and specifications for interoperable and accessible platforms, materials and resources, thus allowing reusability [38] and adaptation to learning styles [39].
- Responsiveness: Meanwhile, UNESCO has published a paper on mobile learning and how mobile technology, which is now more accessible, and therefore LMS designs and platforms must exploit these technologies and adapt their resources to the advances made. Thus, UNESCO defines the following settings for online education and, therefore, technology requirements [40]:

# 4 Research methodology and design

The paper presents a proposed metric for the assessment of LMS platforms that allows institutions and the team responsible for the use of LMS to make an objective decision on the platform to be implemented.

For validation of the proposed metric, experts' opinion was taken into account [23] under the Delphi methodology as this allows to evaluate the model without data or actual experiences. Thus, a group of experts who are familiar with LMS was selected. It should be noted that each LMS may be assessed by two or three experts, according to their expertise in LMS, i.e. teachers and tutors will be in charge of academic or pedagogical criteria or features, while technological and administrative features will be evaluated by support engineers and platform experts.

As mentioned, the following procedure is conducted:

I. Build the model metric based on the review and experience in the field of LMS considering features and attributes of the tools identified in LMS, such as:
   - Content tools
   - Communication tools
   - Assessment and monitoring tools
   - Technical requirements.

II. Set the expert's competence coefficient in order to ensure expert's knowledge of LMS; for this, the expert's level of knowledge of LMS, experience, education and course development were identified [23]

The coefficient of the said study is obtained by applying the following formula [23]:

$$K = \frac{1}{2(K_c + K_a)} \quad (1)$$

Where:

- Kc: "Knowledge coefficient" and information the expert has about LMS. It is calculated based on the assessment by the expert on a 0 to 10 scale, multiplied by 0.1.
- Ka: "Argumentation coefficient" or rationale of experts' criteria. This coefficient is obtained from the assignment of a series of scores to different sources of argumentation found by the expert.

Using the final values obtained, experts are classified in three big groups:

- If K is greater than 0.8, greater than or equal to 1, then there is high influence of all sources.
- If K is greater than or equal to 0.7, greater or less than 0.8, then there is medium influence of all sources.
- If K is greater than or equal to 0.5, greater or less than 0.7 or equal to 0.7, then there is low influence of all sources.

III. Present the model metric to selected experts

Concerning the construction of the metric according to the review of literature and following the model proposed by Olsina (1999) called Web-Site QEM (Web-Site Quality Evaluation Method).

Particularly, for the purpose of this research, three characteristics are established as criteria for constructing the assessment instrument:

- Pedagogical tools or criteria
- Administrative tools or criteria
- Technology tools or criteria.

The first ones refer to elements associated with mediation for learning processes and knowledge, the second ones correspond to actions for managing resources and users as well as tracking elements, and the third alludes to technical and standardization aspects of LMS in order to meet accessibility and usability regulations.

IV. Finally, the metric receives a total score based on experts' judgment.

## 5 LMS Assessment Model

In various pieces of research on evaluation and decision-making to identify LMS platforms for an institution, there are no metrics, indicators or assessment models. However, several features they must have are identified based on common criteria and, in many cases, these are defined for specific domains, such as communication tools, content standards, teaching tools, management tools, among others.

Meanwhile, Menendez & Castellanos (2010) suggest that one difficulty in defining and implementing a learning platform is the lack of quality models tailored to the needs of users (teachers, students, administrator) and, therefore, studies are required to identify not only the features of LMS, but also quality with respect to users' level of satisfaction [41, 42]. Quality in virtual education is understood to the extent that learning is achieved by those who make use of the resources available for this purpose, which means quality content platforms, teachers, and infrastructure [43].

Mueller & Strohmei (2010) set out the conditions that must be considered at the time of designing a learning management system, which is defined as an information system for administrative and teaching support of learning that systematically provides collaboration and communication resources and options.

Moreover, evaluation of LMS is similar to the web site evaluation process. Regarding LMSs, they are also software that must be governed by the principles of quality. Therefore, it is an activity in which numerous factors and features are involved, as well as desirable attributes and increasingly mandatory standards, hence the importance of having a model that enables evaluators to specify these characteristics and attributes in an orderly fashion.

According to the Olsina's model [44] that defines a quantitative and flexible methodology called Web Site Quality Evaluation Method (QEM), it evaluates the quality of centric applications on the web and specifies the desirable and mandatory features and attributes to be evaluate on a more or less complex website. Based on that model, a similar structure for evaluating LMS is presented.

## 5.1 LMS Metrics Model

For the purpose of this work, which is to measure the attributes of LMS and enable institutions to make a decision, a model that includes the preparation of a set of independent metrics focused on the aspects mentioned above, such as teaching tools, administrative tools and technological tools or options, is proposed.

The use of metrics provides quantitative and qualitative criteria for making decisions about which LMS is suitable for training, administrative and technological requirements.

Metrics provide users, evaluators and developers with elements to identify and evaluate quality items of the software product quality and quality management items for future developments and/or adjustments [45].

It should be considered that metrics do not eliminate human judgment in relation to the evaluator's interaction with the LMS. It is desired that the use of metrics within an institution benefit decision-making to the extent that the factors of interest for to the learning process and their relevance to institutional needs are identified.

For the IEEE standard, the metric is defined as a "quantitative measure to the extent that a system, component, or process possesses a given attribute." Metrics can be direct or indirect, internal or external, objective or subjective.

Quality and metrics for an LMS, as mentioned above and according to the reviews and analysis performed, would take into account the following set of features and attributes that meet the requirements of users and institutions to make decisions with respect to LMS.

- Criteria or academic tool metrics: This is the main factor to be considered in a virtual education process because the technology platform LMS must cater to learning needs and facilitate the process of information acquisition, collaborative participation, and mechanisms and strategies for assessment and feedback on students' training progress. The latter includes characteristics associated with pedagogy, communication, content resources and courses, requirements of the student and the teacher, and process of monitoring and progress in the development of the course or learning objects.
- Administrative process metrics: Course management and user management, together with the technical support involved in the implementation of an LMS, are part of one of the characteristics to be evaluated in virtual education platforms. It is very important to have the respective administration to enable resources and contents on platforms.
- Technology metrics: An equally important feature as to the technical and functional requirements supporting the development of courses and modules implemented in LMS. In addition, compliance with standards is part of this feature, providing both accessibility and usability of LMS platforms.

### 5.2 LMS Assessment Tree

In accordance with the above characteristics, attributes have been defined for each of the three characteristics present and necessary on LMS platforms, which are considered relevant at the time of implementation and form the requirement tree shown below:

*Table I presents the features of the academic component, based on academic processes, which in turn have sub-features such as Academic Processes, Web-Based Learning, Collaborative Environment, Evaluations.*

Table I. Academic features

| 1. Academic features |
|---|
| 1.1 Pedagogical |
| 1.1.1 Learning process |
| 1.1.1.1 Pedagogical focus defined |
| 1.1.1.2 Allows to create learning paths according to student profile |
| 1.1.1.3 Oriented to knowledge management |
| 1.1.2 Web-based learning |
| 1.1.2.1 Web 2.0 tools (wiki, blog, RSS, Podcasts) |
| 1.1.2.2 Web 3.0 tools (virtual lab, smart search, virtual world, 3D games) |
| 1.1.2.3 Student portfolio – Personal page |
| 1.1.3 Collaborative environment |
| 1.1.3.1 Social content (student creates contents viewed by others) |
| 1.1.3.2 Role definition (role play) |
| 1.1.3.3 Group and subgroup management |
| 1.1.3.4 Private social network |
| 1.1.4 Assessment |
| 1.1.4.1 Test management |
| 1.1.4.2 Grade book |
| 1.1.4.3 Diagnostic test (previous knowledge) |

*Table II presents a feature of the administrative component, which allows to evaluate what is related to LMS help options, user management, LMS technical support by either a community or the existing documentation available.*

Table II. Administrative features

| 3. Administrative features |
|---|
| 3.1 Help tools and online feedback |
| 3.1.1 Help quality |
| 3.1.1.1 Help explains the platform and its services |
| 3.1.1.2 Tutorial videos |
| 3.2 User management |
| 3.2.1 Single authentication system |

| |
|---|
| 3.2.1.1 User's level of access |
| 3.2.1.2 Teacher's registration system |
| 3.3 Technical support |
| 3.3.1 Manuals, specifically technical adjustments |
| 3.3.1.1 Help manual for the teacher |
| 3.3.1.2 Help manual for the student |
| 3.3.1.3 Support by academic communities |

*Table III presents the technological component, based on the processes associated with the following sub-features of usability, accessibility, interactivity, scalability, standardization, responsiveness and adaptability to future requirements of LMS.*

Using the requirement tree, each attribute is evaluated giving zero (0) if unimportant or irrelevant and ten (10) if very relevant. In this continuum of 0 to 10, there may be intermediate values corresponding to the considerations made by the experts or agents interested in evaluating or making a decision regarding the type of platform to be selected.

According to that score on the scale mentioned, the model defined by Lovelle is taken as a benchmark for evaluating each attribute; therefore, evaluation of the platform (E) is obtained from the combination of several metrics, namely [46]:

$$Ec = C1 * M1 + C2 * M2 + \ldots + Cn * Mn \quad (2)$$

Where:

C1 = Weighing factor of the metric

M1 = Metric to be assessed

Therefore, to measure a feature or sub-feature, the weight of each must be weighted with their metrics or assessment by the expert.

Table III. Technology features

| 2. Technology features |
|---|
| 2.1 Usability |
| 2.1.1 Visual design |
| 2.1.1.1 Resource visibility and platform structure |
| 2.1.1.2 User location indicator |
| 2.1.1.3 Texts adapted to the web |
| 2.1.2 Allows different profiles |
| 2.1.2.1 Alternate itineraries |
| 2.1.2.2 Usability perceived by users |
| 2.1.2.3 Multi-user access modes |
| 2.2 Accessibility |
| 2.2.1 Access to the disabled |
| 2.2.1.1 Visual impairment |
| 2.2.1.2 Hearing impairment |
| 2.2.1.3 Physical disability |
| 2.2.2 Interface design |
| 2.2.2.1 Navigability in different operating systems |
| 2.2.2.2 Navigability in different devices |
| 2.2.2.3 Customization by user |
| 2.2.3 Resource design |
| 2.2.3.1 Available and compressible resources |
| 2.2.3.2 Intuitive access to resources |
| 2.2.4 Access to non-graphic browsers |
| 2.3 Interactivity |
| 2.3.1 Information of access to resources |
| 2.3.1.1 Resource access statistics by student or group |
| 2.3.1.2 Time of access to resources |
| 2.3.2 Completion of activities |
| 2.3.2.1 Monitoring of activity completion |
| 2.3.3 Interaction channels |
| 2.3.3.1 Gamification integration |

| |
|---|
| 2.3.3.2 Allows augmented reality environments |
| 2.4 Scalability |
| 2.4.1 Management of high volumes of data |
| 2.4.1.1 Manages a high number of user at the same time |
| 2.4.1.2 Manages and organizes users in different groups |
| 2.5 Standardization |
| 2.5.1 Compatibility with known standards |
| 2.5.1.1 SCORM |
| 2.5.1.2 IMS (Enterprise / Metadata / Content) |
| 2.5.2 Platform modularity |
| 2.6 Responsiveness |
| 2.6.1 Adjustment to different devices and formats |
| 2.6.1.1 Adapts to different resolutions |
| 2.6.1.2 Adjustment to screen size |
| 2.6.2 Quality in mobile devices |
| 2.6.2.1 Possibility of adjustment to new devices |
| 2.6.2.2 Simple navigability |
| 2.7 Future requirements |
| 2.7.1 Ability of LMS to endure over time |
| 2.7.2 Possibility of being modified according to new needs |

For example, as shown in Table I, the Pedagogical Feature value corresponds to the weighting of the four (4) defined sub-features, namely, 1.1.1 Learning Process, 1.1.2 Web-Based Learning, 1.1.3 Collaborative Environment, and 1.1.4 Evaluations.

Additionally, each feature defines a weight according to the interests and appreciation of the organization. For this work, the weighting of each attribute, sub-feature and feature is consistent with institutional interests.

With respect to that requirement tree and evaluation, each institution can expand features, sub-features and attributes according to its interests and existing standards, which would broaden the spectrum for decision-making. That is to say, they can incorporate both rules and standards such as W3C or NTC5854 (Colombian technical standard), among others or international standards such as AICC, IMS, ADL, and IEEE, for defining the architecture to be considered in such LMS solutions [47]. Likewise weights will be a factor to be discussed and determined by the institution.

## 6 Results

To illustrate the process conducted and consistent with the procedure defined for evaluating platforms, the results obtained for the platform Sakai regarding the technical aspect are presented below (Table IV).

The score obtained by Sakai according to the metric proposed is 1.8, showing a low rating on technical aspects such as responsiveness, accessibility and interactivity, which today has much relevance regarding new online learning models or strategies. However, it is emphasized that the platform is ready to meet new requirements due to its flexibility.

Furthermore, there is a low rating as to how virtual courses are structured, showing difficulty in design and set up of resources and few options for tracking students and collaborative environments.

Table IV. Technical features - Sakai

| | | | | |
|---|---|---|---|---|
| 35% | | 2.Technology features | 1.850 | 0.6475 |
| | 8% | 2.1 Usability | 6.83 | 0.55 |
| | | 2.1.1 Visual design | 6.67 | |
| | | 2.1.1.1 Resource visibility and platform structure | 9 | |
| | | 2.1.1.2 User location indicator | 5 | |
| | | 2.1.1.3 Texts adapted to the web | 6 | |
| | | 2.1.2 Allows different profiles | 7.00 | |
| | | 2.1.2.1 Alternate itineraries | 7 | |
| | | 2.1.2.2 Usability perceived by users | 6 | |
| | | 2.1.2.3 Multi-user access modes | 8 | |
| | 6% | 2.2 Accessibility | 4.42 | 0.27 |

| | | | | |
|---|---|---|---|---|
| | | 2.2.1 Access to the disabled | 5.67 | |
| | | 2.2.1.1 Visual impairment | 7 | |
| | | 2.2.1.2 Hearing impairment | 5 | |
| | | 2.2.1.3 Physical disability | 5 | |
| | | 2.2.2 Interface design | 2.00 | |
| | | 2.2.2.1 Navigability in different operating systems | 2 | |
| | | 2.2.2.2 Navigability in different devices | 3 | |
| | | 2.2.2.3 Customization by user | 1 | |
| | | 2.2.3 Resource design | 5.00 | |
| | | 2.2.3.1 Available and compressible resources | 5 | |
| | | 2.2.3.2 Intuitive access to resources | 5 | |
| | | 2.2.4 Access to non-graphic browsers | 5.00 | |
| | 7% | 2.3 Interactivity | 3.83 | 0.27 |
| | | 2.3.1 Information of access to resources | 6.50 | |
| | | 2.3.1.1 Resource access statistics by student or group | 7 | |
| | | 2.3.1.2 Time of access to resources | 6 | |
| | | 2.3.2 Completion of activities | 4.00 | |
| | | 2.3.2.1 Monitoring of activity completion | 4 | |
| | | 2.3.3 Interaction channels | 1.00 | |
| | | 2.3.3.1 Gamification integration | 1 | |
| | | 2.3.3.2 Allows augmented reality environments | 1 | |
| | 5% | 2.4 Scalability | 6.00 | 0.30 |
| | | 2.4.1 Management of high volumes of data | 6.00 | |
| | | 2.4.1.1 Manages a high number of user at the same time | 6 | |
| | | 2.4.1.2 Manages and organizes users in different groups | 6 | |
| | 4% | 2.5 Standardization | 6.50 | 0.26 |
| | | 2.5.1 Compatibility with known standards | 5.00 | |
| | | 2.5.1.1 SCORM | 8 | |
| | | 2.5.1.2 IMS (Enterprise / Metadata / Content) | 2 | |
| | | 2.5.2 Platform modularity | 8.00 | |
| | 3% | 2.6 Responsiveness | 1.00 | 0.03 |
| | | 2.6.1 Adjustment to different devices and formats | 1.00 | |
| | | 2.6.1.1 Adapts to different resolutions | 1 | |
| | | 2.6.1.2 Adjustment to screen size | 1 | |
| | | 2.6.2 Quality in mobile devices | 1.00 | |
| | | 2.6.2.1 Possibility of adjustment to new devices | 1 | |
| | | 2.6.2.2 Simple navigability | 1 | |
| | 2% | 2.7 Future requirements | 9.00 | 0.18 |
| | | 2.7.1 Ability of LMS to endure over time | 9.00 | |
| | | 2.7.2 Possibility of being modified according to new needs | 9.00 | |

## Conclusions

The demand for platforms and, in particular, for technological tools assisting the training process has also led developers or communities to create technological, academic and administrative mimicries in terms of their development. Therefore, this proposal offers an alternative so that institutions and those responsible for implementing online programs or having LMS to support classroom processes select the platform that best suits their interests and needs. In this regard, it is concluded that:

- Most of LMSs tend to be identical in some aspects, particularly in the design and development of courses.
- It should be noted that a relevant aspect is to have standards not only for the contents but also for the design of online learning environments, which are frequently confused.
- The proposed metric allows institutions to assess and define the weight they deem relevant for the development of virtual education. These criteria should be based on the needs and requirements of the institution, which help select the best platform.
- Using the proposal presented, institutions can define their own weight and start the platform selection process, including other factors defined in different standards.

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