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EVALUATING THE QUALITY OF A LEARNING MANAGEMENT SYSTEM FROM THE PERSPECTIVE OF UNIVERSITY STUDENTS: STRUCTURAL EQUATION MODEL

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ABSTRACT

A study was conducted focusing on the assessment of the quality of a learning management system (LMS) from the perspective of undergraduate students enrolled in the Telematics and Software programs at the Quevedo State Technical University (UTEQ) in Ecuador. A quantitative approach was adopted through the administration of a structured questionnaire, based on four dimensions: technical, pedagogical, usability, and administrative. The methodology included a confirmatory factor análisis (AFC) and estimation using structural equation modeling (SEM), which allowed for the empirical validation of the proposed theoretical structure, demonstrating adequate levels of internal consistency and construct validity. The results revealed predominantly positive evaluations, with particular emphasis on the platform's ease of use and instructional design. Areas for improvement were also identified, such as accessibility, automated feedback, and the availability of technical support. The updated empirical evidence provided by this study may inform the development of institutional strategies aimed at the continuous improvement of digital platform use in university settings.

KEYWORDS: Higher Education, LMS Platform, Quality, Student Evaluation, Confirmatory Factor Análisis, Structural Equation Model.

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INTRODUCTION

In the digital age, LMS platforms have taken on a critical role in higher education, facilitating teaching, learning, and academic administration.

In general terms, LMS platforms are described by Sánchez (2024) as computer systems that offer various tools specifically designed to be used in teaching, they stand as essential and when they are of high quality, they ensure that the needs of their users are satisfied.

Its implementation in Ecuadorian universities has grown exponentially, promoting the virtualization of content, interaction between professors and students, and the optimization of administrative processes. On the other hand, the effectiveness of these digital environments depends to a large extent on their quality, which makes their systematic evaluation essential. Under various approaches, the evaluation of the quality of LMS platforms allows the identification of strengths, weaknesses and opportunities for improvement based on the analysis of various dimensions: technical, pedagogical, usability and administrative, thus providing a comprehensive vision of their performance and contributing to the assurance of quality virtual education.

In addition, the participation of students in the evaluation of LMS platforms promotes a sense of belonging and commitment to their own educational process. By feeling listened to and seeing that their opinions are taken into account, their motivation and satisfaction increase, which can translate into better academic performance. The feedback provided by the students offers a perspective to identify areas for improvement and adapt LMS platforms to the real needs of users. According to Boud et al. (2021), feedback on activities and the use of digital resources in higher education are essential for the continuous improvement of the learning process.

Likewise, Al-Fraihat et al. (2020) point out that having an LMS platform, capable of offering accessible and simple navigation, is essential to improve the user experience and their perception of the quality of the educational service. To achieve this, it is necessary to consider the specific characteristics of the context and of the students themselves, who, in their role as users and beneficiaries of technological resources, require digital environments adapted to their needs and expectations.

The analysis of the quality of LMS platforms has been approached from various theoretical perspectives, including technological, pedagogical and user experience approaches. In other words, they are tools that support learning achievement and, therefore, as Mariño et al. (2020) assert, it is necessary to ensure the quality of these digital environments in order to improve academic processes.

Various authors address the evaluation of LMS platforms. Thus, Ardila & Castro (2015) propose three dimensions for the evaluation of LMS platforms: the pedagogical model, the user and the technique, Berrocal & Megías (2015) establish four dimensions: purpose, design, communication tools and academic aspects, Cordovez et al. (2023) develop a guide for the evaluation of platforms focusing on two of their characteristics: functionality and usability.

Based on a rigorous systematic review of the literature, Mora et al. (2025 a) identify four key dimensions on which the evaluation of the quality of LMS platforms should be comprehensively based: technical, pedagogical, usability and administrative, these dimensions play a fundamental role in determining whether the LMS platform meets the needs of students and contributes to an effective teaching-learning process. associated with the criteria for evaluating the quality of LMS platforms are shown in Table 1.

Table 1: Dimensions and quality evaluation criteria of LMS platforms.

Dimension	Criteria
TECHNIQUE	Functionality
	Security and privacy
	Scalability
PEDAGOGICAL	Instructional Design
	Interactivity
	Evaluation and feedback
	Variety of content formats
	Quality of educational content
USABILITY	Ease of use
	Accessibility
	User satisfaction
ADMINISTRATIVE	Support and maintenance
	Cost – efficiency

Source: Mora et al. (2025 a)

To assess the quality of an LMS platform, different research tools and methods are used. One of the most effective is the application of validated questionnaires, such as the one used in this study. Questionnaires allow data to be collected directly from end users, in this case, university students, providing valuable information about their experience and perception of the LMS platform, according to Álvarez (2015).

The implementation of questionnaires validated using the modified Delphi method has proven to be especially useful in research where a rapid and structured consensus is required, such as the evaluation of educational technologies as Okoli &

Pawlowski (2024) point out, constitutes an efficient strategy to collect user data and make informed decisions about the necessary improvements in the LMS platform. The items that allow evaluating the quality of LMS platforms, according to dimensions and criteria, are shown in Table 2.

Table 2: Ítopics to evaluate the quality of LMS platforms, from the perspective of the students

Dimensions	Criteria	Items
TECHNIQUE	Functionality	I1: The LMS platform allows access to educational materials without technical issues like forgotten password, unstable connection, browser incompatibility, etc.
		I2: The LMS platform provides access to advanced features needed for university teaching, such as session recording, tutorial videos, and engagement analytics.
		I3: The LMS platform allows the enabling of tasks, forums, quizzes, etc., and that they work properly during use.
		I4: Updates to the LMS platform do not interrupt access to academic content and activities.
	Security and privacy	I5: The LMS platform records and examines/verifies login data such as password, profile picture, and email.
		I6: The LMS platform includes resources to educate students about phishing, phishing, and how to identify malicious emails.
	Scalability	I7: The design and development of the LMS platform responds appropriately even when many students use it at the same time.
		I8: The design and development of the LMS platform has the capacity to adapt to different modalities of face-to-face, online or hybrid courses.
PEDAGOGICAL	Instructional Design	I9: The LMS platform makes it easy to search for materials and resources in a logical and organized way.
		I10: The platform offers suitable tools to develop collaborative activities among students.
		I11: The interface design of the LMS platform is intuitive and engaging.
	Interactivity	I12: The design and development of the LMS platform facilitates interaction between students and teachers (discussion forums, messages, instant messages).
		I13: The LMS platform provides notifications, reminders/notices about assignments, exams, academic progress, etc.).
	Evaluation and feedback	I14: Assessment tools (exams, assignments) are easy to use and offer useful feedback on the LMS platform.
		I15: I can see grades and activity progress in a clear and up-to-date way on the LMS platform.
		I16: The platform's assessment tools include anti-plagiarism detection and AI recognition systems.
	Variety of content formats	I17: The LMS platform allows didactic-educational content to be offered in different file formats such as jpeg, gif, avi, mp3, pdf, etc.
		I18: The LMS platform offers access to a variety of educational tools and resources, such as videos, readings, presentations, and interactive activities (games).
	Quality of educational content	I19: The tools and resources available on the LMS platform such as videos, readings, forums, are useful and effective in the teaching-learning process.
		I20: The didactic-educational content of the LMS platform (videos, audios, images) is of high quality and enriches learning.
USABILITY	Ease of use	I21: The LMS platform is easy to use on all kinds of technological devices like mobile phones, tablets, computers, etc.
		I22: The main functions (task delivery, access to content) are clearly visible and easy to locate in the LMS platform.
	Accessibility	I23: The LMS platform guarantees inclusive access and use, respecting the functional diversity of all students.
		I24: The LMS platform allows you to adjust settings such as text size, colors or contrast, to improve the user experience.
	User satisfaction	I25: I am satisfied with the overall performance of the LMS platform for academic studies.
		I26: The general characteristics of the LMS platform are adequate and sufficient to achieve the proposed academic objectives.
ADMINISTRATIVE	Support and maintenance	I27: LMS platform support is available when needed and resolves issues quickly (login issues, content loading, task delivery failed, etc.).
		I28: The LMS platform includes guides and resources to help solve common problems.
	Cost-efficiency	I29: The LMS platform is an efficient tool in terms of time and performance to fulfill academic activities.
		I30: The design and development of the LMS platform allows access to information, resources, and tools that would be expensive or difficult to obtain otherwise.

Source: Own elaboration

In addition, with the definition of dimensions, criteria and quality assessment items of LMS platforms, Table 3 presents the complete theoretical model:

Table 3: Proposed theoretical model for the evaluation of LMS platforms.

Quality of LMS Platforms	**Technical**	**Functionality**	**I1**
			I2
			I3
		Security and Privacy	I4
			I5
		Scalability	I6
			I7
	Pedagogical	Instructional Design	I8
			I9
			I10
		Interactivity	I11
			I12
		Evaluation and Feedback	I13
			I14
			I15
		Variety of Content Formats	I16
			I17
		Quality of Educational Content	I18
			I19
	Usability	Ease of Use	I20
			I21
		Accessibility	I22
			I23
		User Satisfaction	I24
			I25
	Administrative	Support and Maintenance	I26
			I27
		Cost - Effectiveness	I28
			I29
			I30

Source: Own elaboration

The objective of this study is to analyze the assessment made by students of the Telematics and Software careers of the UTEQ, regarding the quality of the institutional LMS platform. To this end, a quantitative methodological approach is adopted, based on the application of a structured questionnaire. The evaluation considers the following dimensions: technical, pedagogical, usability and administrative.

The research is relevant for providing empirical evidence on the quality of an LMS platform in a university context in Ecuador, characterized by a digital divide and regional inequalities, scheduled or unforeseen power outages, connectivity problems and personal devices, among other structural and technological factors that directly affect the use and evaluation of virtual learning environments. which justifies the need for studies that analyse their impact on the experience and perception of students.

MATERIALS AND METHODS

The research used a quantitative methodology and instruments. The research design was non-experimental of a descriptive cross-sectional type, which has the characteristic of investigating the status of one or more variables in a given population, in a single time, according to Hernández-Sampieri & Mendoza (2018), all of which was aligned with similar approaches in educational technology assessment, indicated by Al-Fraihat et al. (2020).

The UTEQ was selected as the study context due to its active implementation of an LMS platform and the fact that the Telematics and Software careers, whose students have a high demand for digital skills, offer an ideal profile to reinforce the internal validity of the analysis. The sample, composed of 217 students from these careers, was determined using the formula for finite populations proposed by Murray & Larry (2009), guaranteeing representativeness within a known universe. The fieldwork was carried out in March 2025.

To obtain information, a questionnaire developed by Mora et al. (2025 b) was applied, who obtained it by validating the modified Delphi method through expert judgment. The scores of the items are given according to the criteria of the Likert scale from 1 to 5 (1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree; 4=Agree and 5=Strongly agree).

Anonymity and confidentiality of participants were ensured at all stages of the study. All students participated voluntarily and their informed consent was obtained prior to the application of the questionnaire.

The type of sample was directed (non-probabilistic), 217 responses were collected, of which 119 corresponded to the Software career, which is equivalent to 54.84% and 98 to the Telematics career, which is equivalent to 45.16% of the total respondents.

The gender study provided relevant information on the distribution of respondents according to their gender identity. The category with the highest representation corresponds to the male gender, with a total of 134 responses, which is equivalent to 61.75% of the total number of respondents. The percentage of female participants was 32.7%.

The analysis of the age variable allowed us to identify the predominant age group among the study participants, the category with the highest representation was from 18 to 21 years old, with a total of 134 responses, which is equivalent to 61.75% of the total respondents.

The level of studies showed according to the results obtained, that the largest number of participants was in the first and second semesters with 123 students, which represents 56.68% of the total number of respondents. This suggests that most of the respondents are in an initial stage of their professional training, the sample did not participate

in the fourth, fifth and sixth semesters because they did not have students enrolled in the respective cohorts. Table 4. The characteristics of the study sample are detailed:

Table 4: Sociodemographic data of participants.

Sociodemographic variable		Frequency	Percentage (%)
AGE	18 - 21 years old	134	61,75
	22 - 25 years old	75	34,56
	26 years or older	8	3,69
GENDER	Male	134	61,75
	Female	71	32,72
	Other	12	5,53
CAREER	Software	119	54,84
	Telematics	98	45,16
LEVEL OF EDUCATION	1	78	35,94
	2	45	20,74
	3	31	14,29
	7	15	6,91
	8	27	12,44
	9	21	9,68

Source: Own elaboration

Various techniques were used to analyse the data obtained, depending on the objectives: reliability and validity tests, descriptive and correlational analyses.

The SEM model was used, which allows empirically measuring the influences between variables in the social sciences and theoretically testing causal models, as pointed out by Martínez & Fierro, (2018). For this purpose, the proposal of Salessi (2020) was adopted, following the following steps: (a) Development of a model based on theory, (b) Construction of a relationship diagram, (c) Conversion of the relationship diagram to SEM and specification of the measurement model, (d) Evaluation of the SEM model and (e) Evaluation of the estimation and goodness of fit of the model.

In order to evaluate the validity of the model, an AFC was carried out that had as input the model obtained from the Exploratory Factor Analysis (AFE). As Batista-Foguet et al. (2004) point out, the TFA always requires the existence of an articulated theory that serves as a basis for the elaboration of a model whose empirical testing is being analyzed.

Once the model was defined, it was verified that the correlation matrix was significant ($p<0.05$) and the adjustment indices were calculated, where the method indicated by Jacobucci et al. (2016) of maximum likelihood estimation was used, taking as a reference the theory and the resulting modification indices.

SPSS statistical software was used for data processing and AMOS.26 for the specification of relationships between variables, parameter estimation, and evaluation of SEM model fit.

RESULTS AND DISCUSSION

Regarding the measurement of reliability, Cronbach's Alpha statistic was applied, which allows measuring internal consistency, as well as the degree to which the answers obtained are consistent across the items as indicated by Maese et al. (2016), having obtained a value of 0.93, which corresponds to excellent reliability.

On the other hand, the Kaiser-Meyer-Olkin sample adequacy measure (KMO = 0.934) and the statistical significance of the Bartlett sphericity test ($\chi^2 = 0.0$; $df = 435$; $p < 0.001$) show an ideal correlation matrix for the application of the TFA, corroborating what Méndez (2024) pointed out about the relevance of the data to identify robust latent relationships between the items of the instrument, considering values above 0.80 as appropriate for factoring in the case of KMO, and less than 0.05 for the sphericity test. See Table 5.

Table 5: Descriptive statistics in each of the items.

Items	Media		Desv. typ.	Variance
	Statistician	Typical error		
I1	3,45	0,07	1,07	1,14
I2	3,43	0,07	0,98	0,96
I3	3,78	0,06	0,92	0,84
I4	3,43	0,07	0,98	0,96
I5	3,87	0,06	0,94	0,88
I6	3,45	0,07	0,97	0,93
I7	3,53	0,07	1,01	1,03
I8	3,65	0,06	0,93	0,86
I9	3,76	0,06	0,92	0,85
I10	3,55	0,07	0,97	0,93
I11	3,82	0,07	0,99	0,97
I12	3,42	0,07	1,01	1,01
I13	3,59	0,07	1,02	1,05
I14	3,59	0,07	0,99	0,98
I15	3,79	0,07	0,97	0,94
I16	3,35	0,07	1,06	1,12
I17	3,68	0,07	0,96	0,92
I18	3,56	0,06	0,91	0,83
I19	3,69	0,06	0,81	0,65
I20	3,61	0,06	0,91	0,83
I21	3,77	0,06	0,94	0,89
I22	3,65	0,06	0,93	0,87
I23	3,70	0,06	0,90	0,81
I24	3,49	0,07	1,01	1,01
I25	3,68	0,06	0,93	0,87
I26	3,67	0,06	0,87	0,76
I27	3,50	0,07	0,98	0,96
I28	3,55	0,07	0,95	0,91
I29	3,66	0,06	0,95	0,89
I30	3,67	0,07	0,99	0,98
Averages	**3,61**	**0,07**	**0,96**	**0,92**

Source: Own elaboration

Table 5. presents the basic descriptive statistics for the entire sample and as can be seen high values are recorded in all items, with an average mean of 3.61, which indicates a high general trend in the responses. The highest value observed is 3.87 and the lowest is 3.35, which shows that there are no major extreme differences between the items: they are all concentrated at relatively high levels.

The average standard deviation is 0.958, which suggests a moderate variability in the responses; that is, although in general people tend to respond highly, there is a certain dispersion in opinions. The most dispersed item has a deviation of 1.066 and the least dispersed 0.807. The average variance of 0.920 also confirms that the dispersion is moderate, which shows a homogeneity in the valuations of the items.

The exploratory analysis shows that the responses are mostly positive (medium-high), but with some moderate variability among the students surveyed.

Once the levels of reliability and validity had been evaluated, the approximate fit measures of the model were analyzed, as established by Hair et al. (2019). Table 6. The values obtained from the different adjustment indices of the model are presented.

Table 6: Global Adjustment Indices.

Table of Contents	Value	Good Fit Criteria
Chi-square (χ^2)	717,714	No significant ($p > 0.05$)
Comparative Fit Index (CFI)	0,886	≥ 0.90 (optimal ≥ 0.95)
Tucker-Lewis Index (TLI)	0,862	≥ 0.90
Root Mean Square Error of Approximation (RMSEA)	0,063	≤ 0.08 (optimal ≤ 0.05)

Source: Own elaboration

The overall fit of the model shows acceptable indices that are close to the recommended standards. The Chi-square index was significant ($\chi^2 = 717.714$), which is common in large samples, while the CMIN/DF index = 1.859 is within the ideal range (< 3), indicating a reasonable relationship between the complexity of the model and its explanatory capacity.

The results derived from the TFA provide sufficient empirical evidence to affirm that the proposed theoretical model presents an acceptable overall fit to the observed data, which supports its structural validity in the context of the evaluation of the quality of an LMS platform.

In addition, the value of the RMSEA index (Root Mean Square Error of Approximation) was 0.063, which is within the range that is considered to indicate a reasonable adjustment (values less than 0.08). That is, the 90% confidence interval (0.056–0.070) reinforces this interpretation, although the PCLOSE statistic value (0.002) suggests that the fit cannot be stated with a high confidence level (PCLOSE > 0.05). This result points to the need for future improvements to achieve a more robust fit.

In addition, the incremental fit indices, in particular the IFI (Incremental Fit Index = 0.889), the TLI (Tucker-Lewis Index = 0.862) and the CFI (Comparative Fit Index = 0.886) have values close to the threshold of 0.90, an indicative reference of a good fit, therefore, they support the general acceptability of the model, which could be subject to subsequent improvements.

Finally, the CMIN/DF index, with a value of 1.859, is below the critical threshold of 2.0, indicating the appropriate fit of the model. This index assesses the fit considering the complexity of the model and suggests that the relationship between the data and the proposed structure is reasonably satisfactory.

Overall, the results obtained allow us to conclude that the quality assessment model of the LMS platform has a solid statistical basis that validates its theoretical structure.

Fig. 1 represents the dimensionally correlated model that evaluates the quality of LMS platforms, based on multiple latent and observable dimensions, organized around four major second-order factors. Each of these second-order factors groups first-order constructs, which, in turn, are made up of observable items.

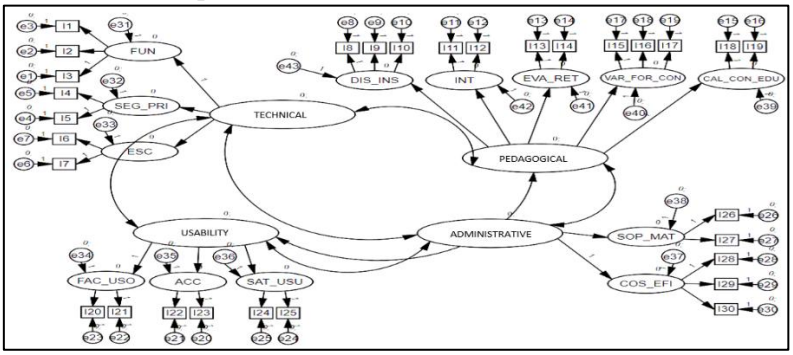

Fig 1: Dimensionally correlated model of quality
Source: Own elaboration

From a statistical point of view, the model shows a well-defined hierarchical structure. The one-way arrows (indicated by standardized values close to 1 or 0) represent factorial load relationships between the latent variables and their respective items. Most of these loads are in the acceptable range (ideally > 0.50), which indicates a good representation of the items with respect to their underlying factors.

Likewise, the covariances between second-order dimensions (indicated by the double curved arrows) suggest a significant relationship between the different aspects of the quality evaluated, reinforcing the interdependent nature of the components of the LMS system.

Fig. 1 suggests that the model has a theoretically sound and statistically coherent structure, in which the observed variables adequately reflect the latent constructs, and these in turn are grouped into higher dimensions that explain the overall quality of the LMS platform.

The AFC results indicate that the proposed theoretical approach, based on four latent dimensions: technical, pedagogical, usability and administrative, has an adequate factorial structure to represent the students' perception of the quality of the LMS platform.

The SEM model was used to evaluate the relationship between the criteria and items and their respective dimensions. Fig. 2 shows the standardized factor loads. Using the maximum likelihood method (MLE), factor weights (loads), variances and covariances of latent factors, and measurement errors were estimated.

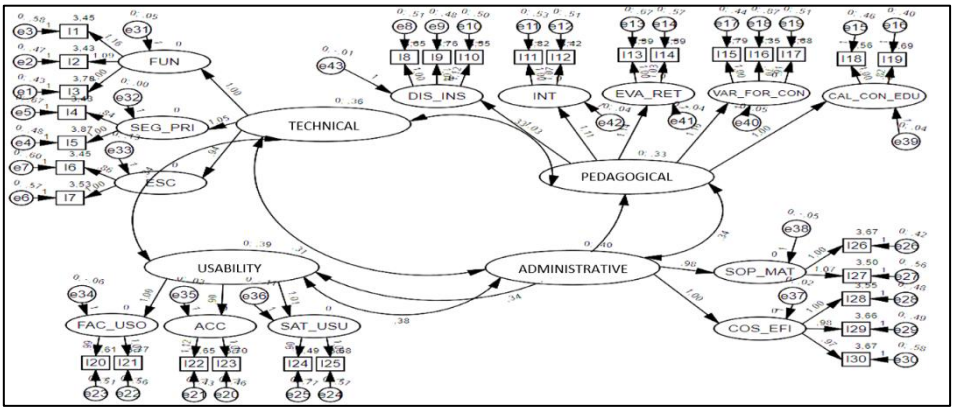

Fig 2: Structural equation model
Source: Own elaboration

The criteria of the pedagogical dimension (such as evaluation and feedback, variety in content formats, quality of educational content, interactivity and instructional design) present standardized factor loads greater than 0.9 in most cases, which shows a strong link between the items and the construct.

The technical dimension, made up of the criteria of functionality, security and privacy and scalability, showed high estimates (0.84), which suggests that students perceive technical aspects as fundamental for their experience on the platform. Especially noteworthy is the relationship between the technical dimension and the security and privacy criterion (1.0), a finding consistent with the growing concern for the protection of personal data in digital environments.

On the other hand, the usability dimension obtained very prominent factor loads, particularly in the criteria ease of use (1.0), accessibility (0.90) and user satisfaction (1.01), with multiple correlation squared values above 0.9 in most of the items, which underlines its relevance in the user experience.

The administrative dimension, composed of support and maintenance and cost-efficiency, also showed a good adequacy with loads above 0.95, which indicates a clear perception of the students about the efficient management of resources and content.

In the AFC framework, and with the use of MLE as an estimation technique, as shown in Table 7. The covariances of the proposed model were obtained.

Table 7: Covariances of the model.

DIMENSIONS			ESTIMATE	H.E.	C.R.	P	LABEL
Usability	<-->	pedagogical	0,341	0,053	6,438	***	par_23
Usability	<-->	Administrative	0,385	0,058	6,681	***	par_24
pedagogical	<-->	Administrative	0,336	0,053	6,392	***	par_26
Technical	<-->	Administrative	0,315	0,050	6,246	***	par_27
Technical	<-->	pedagogical	0,329	0,052	6,391	***	par_28
Usability	<-->	Technical	0,336	0,053	6,405	***	par_32

Source: Own elaboration

The analysis of the covariances between the latent dimensions of the model: technical, pedagogical, usability and administrative, the results obtained through the MLE show positive and statistically significant relationships between all pairs of factors. These findings are consistent with the proposed theoretical structure, as they reflect the functional interdependence between the different components that make up the quality of an LMS platform.

The most prominent associations were observed between usability and administrative (0.385), as well as between usability and pedagogical (0.341), which suggests that an accessible and friendly interface not only facilitates navigation, but also affects the perception of administrative efficiency and the quality of the educational process. On the other hand, the relationships between the technical dimension and the other pedagogical and administrative dimensions and usability were also significant (with values between 0.315 and 0.336), which highlights the structural role of technological robustness as a transversal support for the operation of the platform.

The pattern of covariances indicates that while each dimension represents a specific aspect of the quality of the LMS platform, they are all closely articulated, contributing in an integrated way to the user experience. These results strengthen the structural validity of the proposed model, by empirically confirming the internal coherence between the defined theoretical components.

Subsequently, the level of association between the dimensions was identified through the analysis of Pearson's correlation matrix.

As shown in Table 8. The correlations observed between the latent factors reveal a significant interdependence between the various dimensions analyzed.

Table 8: Analysis of correlations between dimensions, with Pearson's coefficients.

Dimensions compared			Correlation
Usability	<-->	pedagogical	0,955
Usability	<-->	Administrative	0,966
pedagogical	<-->	Administrative	0,925
Technical	<-->	Administrative	0,830
Technical	<-->	pedagogical	0,967
Usability	<-->	Technical	0,900

Source: Own elaboration

Particularly high coefficients are highlighted between the technical and pedagogical dimensions (r = 0.967), as well as between usability and administrative (r = 0.966), suggesting the existence of a synergistic interaction between the technological and pedagogical aspects of the LMS platform. This interaction could have a direct impact on the overall perception of the quality of the system. In this way, it is evident that the user experience in the LMS platform has an essentially multidimensional character, in which each dimension reciprocally influences the others, configuring a comprehensive perception of the learning environment.

In an AFC, multiple squared correlations (R^2) indicate the variability and validation of each item in relation to its dimensions and criteria. High values of R^2 (greater than 0.50) indicate that the item is a good reflection of the construct it measures, while low values suggest that the item could have problems of interpretation by the students or of relevance in relation to the dimension it intends to measure.

Table 9. The multiple correlations squared (R^2) obtained are shown, the R^2 values for the analyzed items vary in a range from 0.217 to 0.528, approximately, observing that: most of the items have moderate R^2 (between 0.40 and 0.50), some items have low R^2 (below 0.40), few items exceed 0.50.

Table 9: Multiple correlations squared (R^2)

CRITERIA	R^2	Items	DIMENSIONS			
			Technique	Pedagogical	Usability	Administrative
Functionality	0,877	I1	0,484	-	-	-
		I2	0,504	-	-	-
		I3	0,486	-	-	-
		I4	0,295	-	-	-
Security and Privacy	0,988	I5	0,455	-	-	-
		I6	0,357	-	-	-
Scalability	0,702	I7	0,442	-	-	-
		I8	0,399	-	-	-
Instructional Design	1,019	I9	-	0,434	-	-
		I10	-	0,461	-	-
		I11	-	0,45	-	-
Interactivity	0,915	I12	-	0,498	-	-
		I13	-	0,363	-	-
Evaluation and Feedback	1,116	I14	-	0,414	-	-
		I15	-	0,528	-	-
		I16	-	0,217	-	-
Variety of FormatsContent	0,896	I17	-	0,441	-	-

		I18	-	0,448	-	-
Quality of Educational Content	0,880	I19	-	0,388	-	-
		I20	-	0,387	-	-
Ease of use	1,194	I21	-	-	0,37	-
		I22	-	-	0,502	-
Accessibility	0,923	I23	-	-	0,43	-
		I24	-	-	0,236	-
User Satisfaction	1,372	I25	-	-	0,336	-
		I26	-	-	0,449	-
Support & Maintenance	1,157	I27	-	-	-	0,408
		I28	-	-	-	0,467
Cost-effectiveness	0,960	I29	-	-	-	0,452
		I30	-	-	-	0,404

Source: Own elaboration

This suggests that, although the model is adequate, there is room for improvement in several items to strengthen its relationship with theoretical factors. Values greater than 1 observed in some latent variables (e.g., SAT_USU = 1.372; FAC_USO = 1.194) may indicate an overestimation related to collinearity between indicators, which should be explored in subsequent analyses.

RESULTS BY DIMENSION

a) Technical dimension. Criteria: functionality, security and privacy, scalability.

The functionality items (I1-I4) have moderate R^2 (0.295 to 0.504), highlighting that I4 (LMS platform updates do not interrupt access to academic content and activities), has the lowest value (0.295).

The security and privacy items (I5-I6) have low to moderate R^2 (0.357 and 0.455), indicating weakness in their representation. The scalability items (I7-I8) remain between 0.399 and 0.442, in an acceptable way, although there is room for improvement.

The technical aspects of the platform are recognized by the students, but some items, such as update management and cybersecurity education, need to be strengthened in the LMS platform experience.

b) Pedagogical dimension. Criteria: instructional design, interactivity, evaluation and feedback, variety of formats, quality of content.

The Instructional Design items (I9-I11) have R^2 from 0.434 to 0.461 considered adequate. In interactivity (I12-I13), item I12 remains acceptable (0.498), but I13 ("notifications, reminders") falls to 0.363, evidencing weakness. In evaluation and feedback (I14-I16), a particularly low R^2 stands out for I16 (The platform's evaluation tools include anti-plagiarism detection and AI recognition systems), with just 0.217. In variety of formats and content quality (I17-I20), R^2 are around moderate values (0.387 to 0.448), indicating acceptable but not outstanding perception.

Although most of the pedagogical items are functional, it is evident that automatic feedback, advanced technologies (such as AI) and anti-plagiarism systems are not clearly perceived by the students, which suggests opportunities for improvement in the service of the LMS platform.

c) Usability dimension. Criteria: ease of use, accessibility and user satisfaction.

In ease of use (I21-I22), I21 has a low R^2 (0.37), and only I22 exceeds 0.50. In accessibility (I23-I24), the values are low, especially the adjustment of visual settings (0.236). User satisfaction (I25-I26) shows a moderate behavior (0.336 and 0.449).

The basic ease of use is well perceived, but aspects of accessibility and inclusion are weakly recognized. This may reflect a deficiency in the inclusive design of the LMS platform or a lack of awareness among students.

d) Administrative dimension. Criteria: support and maintenance and cost-effectiveness.

In support and maintenance (I27-I28), R^2 are around reasonable values between 0.408 and 0.467. In cost-effectiveness (I29-I30), the values are acceptable and are between 0.404 and 0.452.

CONCLUSIONS

The AFC, framed in the use of the SEM model and optimized by the MLE, showed that the proposed theoretical model has an adequate statistical fit and a coherent factor structure, confirming the validity of the questionnaire to evaluate the quality of an LMS platform in the university context in Ecuador, from the perspective of the students. The dimensions: technical, pedagogical, usability and administrative, were confirmed as interrelated but distinguishable latent factors, highlighting usability and the pedagogical dimension as articulating elements in

the digital educational experience.

The students positively valued aspects such as ease of navigation, access to teaching materials and academic management. On the other hand, areas for improvement were identified, including interoperability with other systems, synchronous interaction between teachers and students, and certain elements of content organization. Deficiencies in user service and technical support were also pointed out, aspects that have a direct impact on overall satisfaction.

Overall, the findings highlight the need for a multidimensional and continuous evaluation of the LMS platform, training students in aspects of digital security, accessibility and new technologies, review of updating, maintenance and support mechanisms, anti-plagiarism tools and inclusive configurations. While the platform meets acceptable standards, improving the aspects detected will contribute to a more comprehensive experience.

Finally, the focus on students of technological careers and the transversal nature of the study are recognized as limitations.

As future work, it is recommended to replicate the study in other universities with diverse socioeconomic contexts and academic disciplines, incorporating longitudinal approaches to analyze the evolution of student perception, and complementing quantitative data with qualitative interviews or student discussion groups that help to explore in depth the technical and pedagogical barriers identified in the research.

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