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Assessing the Quality of LMS Platforms in Higher Education Institutions: A Systematic Literature Review

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ABSTRACT

This study aimed to identify the most relevant articles published between 2018 and the first quarter of 2024, on the evaluation of the quality of LMS platforms, at the university level, through a scientific Systematic Literature Review (RLS), according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, in the Scopus databases, WOS and ERIC. To this end, 153 publications were initially analyzed, which, after the elimination of duplicate citations, were reduced to 144 and the application of inclusion and exclusion criteria, resulted in a total of 46 contributions with the purpose of offering a vision of quality assessment in LMS (Learning Management Platforms) platforms. This systematic review of the literature has identified and analyzed the approaches proposed by various authors in relation to four key dimensions for the evaluation of the quality of LMS platforms: technical, pedagogical, usability and administrative. The results reflect that there are several dimensions and criteria that help us understand what a true evaluation of the quality of LMS platforms at the university level should be. The discussion focuses on the identification and clarification of the dimensions and criteria for the evaluation of LMS platforms, the current limitations and the need to propose future lines of research that include the development of evaluation instruments in various universities, expand the geographical context, analyze the organizational impact, examine more variables and external factors, that are contextualized for different virtual environments, in order to promote a more inclusive and accessible education.

Keywords: e-learning, LMS platforms, online platform, evaluation, quality, assessment, university y higher educations.

1. INTRODUCTION

Due to the COVID-19 pandemic, all educational stages were forced to adapt quickly to online teaching. At the international level, there was relative agreement on the response (Pulido-Montes & Ancheta-Arrabal, 2021) and more than 190 countries closed their schools at some point, leading to approximately 1600 million students and 100 million teachers working from home (UNESCO, 2021). In this way,

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online education gradually became the "new normal" in Higher Education Institutions (HEIs) (Marciniak & Rembielak, 2022; Valdés & Ganga-Contreras, 2020; Xie, Siau & no, 2020).

HEIs were forced to adopt and integrate Information and Communication Technologies (ICT) to face the opportunities and challenges related to the transition from face-to-face teaching to online education. And, in those early moments, Brown & Salmi (2020) already alerted us to the shortcomings and inequalities they showed both in the availability of resources and in the preparation and training of teachers and students.

Although, since the beginning of the twenty-first century, ICTs have been gradually introduced at the educational and curricular level, after the pandemic, technological advances in higher education have accelerated (Myyry et al., 2022; Sutikno & Aisyahrani, 2023), it is increasingly evident that teachers need support to learn how to use these tools effectively in teaching and learning processes (Pérez-López & Yuste, 2023; Zhao, Pinto & Sánchez, 2021).

In this scientific article, the term "LMS platform" is used as a generic term that encompasses various denominations used in the academic literature, such as online platform, virtual platform, digital platform, e-learning platform, electronic platform, among others. This choice responds to the need to unify under a single term the different linguistic variants that refer to systems and/or technological environments designed for the management of learning in educational contexts.

In this sense, LMS platforms are described as computer systems that offer various tools specifically designed to be used in teaching (Foix & Savando, 2003), they are essential (Wu, 2024) and when they are of high quality, they ensure that the needs of their users are satisfied. Thus, Cáceres, Gálvez & Rivas (2021) state that having an adequate virtual platform or campus supports the teaching-learning process, providing a high-quality virtual education experience. This experience allows the same activities to be carried out that are carried out on the university campus, but in a non-physical environment, taking advantage of the technological opportunities of the 21st century to effectively satisfy all the necessary processes.

Today, LMS platforms act as intermediary tools to facilitate teaching and learning in different types of educational environments. Teachers use them to support training in face-to-face, blended, and virtual learning modalities, with the aim of complementing and improving their courses (Delgadillo et al., 2023).

Currently, HEIs are immersed in a broad digital transformation towards improving educational coverage, relevance, and quality at all levels (Acevedo et al., 2022); although it must be admitted that quality is a multidimensional, relative, subjective and ambiguous concept (Krause, 2012; Watty, 2006).

Quality assessment in HEIs is a non-standardized process that depends on each university institution. The digitalisation of teaching and the situations that have occurred in recent times has led to a notable increase in the interest and relevance of e-learning in teaching-learning processes (Ortiz-López, Olmos-Migueláñez & Sánchez-Prieto, 2021).

In the usual practice of computer-assisted education, the LMS platform is the main resource that facilitates online learning. 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.

Thus, Ortiz-López, Olmos-Migueláñez & Sánchez-Prieto (2022), confirm the high number of current studies on the assessment of the quality of e-Learning education, but despite the high use of LMS platforms as an important tool in educational processes, there is little current research that properly evaluates the quality assessment of LMS platforms *per se* (León et al, 2021); In this sense, some of the most significant results stand out:

According to Mtebe & Raisamo (2014), the dimensions of course quality, system quality, and student

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satisfaction are essential for the effective use of LMS platforms, adding pedagogical quality (Haryani & Poniam, 2021), including the quality of teaching, interactivity, and student understanding.

In 2003, Toro & Carrillo presented a proposal for quality indicators for virtual training platforms focused on three areas of analysis: technical, organizational and creative and communicational; in addition, they included contributions from cognitivist and constructivist theories of design of didactic processes of a virtual nature to specify these indicators in the evaluation of LMS platforms.

For their part, Ardila & Castro (2015) proposed three dimensions for the evaluation of LMS platforms: the pedagogical model (inclusion, formative assessment, continuous assessment and effective learning), the user model (accessibility, usability and tools offered) and the technique (durability, packaging, reliability, functionality, efficiency, reuse, interoperability and portability). That same year, Berrocal & Megías (2015) established four dimensions (Purpose, Design, Communication Tools and, finally, Academic Aspects) creating an instrument for the evaluation of indicators in LMS platforms from a multidisciplinary perspective.

A little earlier, Chacón-Rivas & Solano (2009) had already considered evaluating LMS platforms based on four factors: technological, support, pedagogical, and accessibility. For their part, León et al. (2021) identify four dimensions that determine the quality of LMS platforms: design aspects, available tools, academic aspects, and the degree of user satisfaction.

Cordovez, Bastidas & Noriega (2023) built a guide for the evaluation of online platforms considering two of their characteristics: functionality and usability; The proposed guide presents three evaluation phases: technical, usability and global of the platform. Similarly, from a software engineering approach, Ouadoud et al. (2016) approached the evaluation of online platforms, particularly through the dimensions of utility and usability.

From the combination of the above approaches, four dimensions have been identified on which the evaluation of the quality of LMS platforms should be based:

- Technical: It focuses on the technical aspects that affect the operability and security of the platform.
- Pedagogical: Evaluates the support that the platform provides to the teaching work and the quality of the educational content.
- Usability: This refers to how easily users can learn and use a platform.
- Administrative: Ensures compliance with institutional requirements and facilitates efficient management of educational resources.

The main dimensions and criteria for evaluating the quality of LMS platforms are shown in Table 1:

DIMENSION	CRITERION	KEY CONCEPT
Technique	Functionality	Ability of the platform to fulfill the functions necessary for learning and teaching. It includes the evaluation of features such as content management, communication tools, and compatibility with various devices (Sanchis, 2013).
	Security and Privacy	It assesses the protection of users' personal data and the security of the information stored and transmitted through the platform (Postigo, 2020).
	Scalability	Enabling the platform to improve a growing number of users and resource demand without loss of performance (Rodríguez et al., 2020).
	Instructional	Effectiveness of the platform in the implementation of

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Pedagogical	Design	pedagogical activities and its alignment with contemporary educational theories and practices (SUMMA, 2022).
	Interactivity	The provision of tools that promote interaction among the students themselves (Salcedo, 2019).
	Evaluation and Feedback	Capacity of the platform to facilitate continuous assessment and provide constructive feedback to students (Walss, 2021).
	Variety of content formats	Availability of different types of resources (textual, visual, etc.) and formats (Othmani et al., 2018).
	Quality of educational content	Analysis of the quality and relevance of the content offered (González, 2011).
Usability	Ease of use	Intuitousness of the interface and the ease with which users can navigate and use the different functionalities of the platform (Sanchis, 2013).
	Accessibility	Potential of the platform to be used by students with functional diversity, complying with web accessibility standards (Ricardo, González & Nprchales, 2010).
	User satisfaction	Users' general perception of their experience with the platform, including aspects of satisfaction and usability (Ramírez, 2021).
Administrativa	Support & Maintenance	Availability of technical support and ability of the platform to receive updates and regular maintenance (Belloch, 2012).
	Cost - Efficiency	Relationship between the costs associated with the implementation and maintenance of the LMS and the educational benefits it provides (Mar et al., 2024).

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

2. PURPOSE

The significant number of previous publications on LMS platforms indicates a high level of interest from the scientific community in this field of study, which, logically, has expanded in response to COVID-19 and within the framework of a society that increasingly integrates ICT into every facet of its life. However, in the same way, the lack of previous systematic reviews on the evaluation of the quality of LMS platforms is relevant, which shows a lack of interest on the part of this same community.

The general objective of this systematic review is to identify and systematize the dimensions and criteria proposed to evaluate the quality of LMS platforms through the systematic review of articles published and indexed in the Scopus, WOS and ERIC databases, between 2018 and the 1st quarter of 2024.

The decision to carry out this systematic review is based on two main reasons: on the one hand, to provide a complete analysis of the quality assessment of LMS platforms in HEIs in a single document; and, on the other hand, to lay the foundations for future research on the subject, since this is the first attempt to synthesize the knowledge that is available on the subject. The identification and selection of dimensions and criteria to assess the quality of HEI LMS platforms is especially relevant for institutions to optimize learning environments and enhance their student outcomes.

The following research questions were posed in this review:

1. What relevant articles indexed in the Scopus, WOS and ERIC databases have been published between 2018 and the 1st quarter of 2024 on the quality assessment of LMS platforms in HEIs?

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2. What dimensions and criteria are proposed to evaluate the quality of LMS platforms in HEIs?

3. METHOD

The literature review should summarize the current status of relevant research that situates the work within the international context, and should explain how the conclusions of other authors are being examined or expanded in this field. The study has been carried out under a mixed approach, of a descriptive exploratory type, in order to obtain an overview of the existing articles, summarize the data extracted and group the selected research according to the dimensions and criteria established for the evaluation of the quality of LMS platforms in HEIs, ensuring the exhaustiveness of the research process.

The PRISMA declaration for systematic literature reviews (Sánchez-Serrano, Pedraza-Navarro & Donoso-González, 2022) has been followed, which establishes the essential elements and guidelines necessary to address key aspects in this type of research; in addition, it helps to make the process transparent and allows other researchers to both replicate the study and update it (Page et al., 2021). The presentation of this methodological section was based on the work of Moore and Blackmon (2022).

Figure 1 shows the flow chart of the search and selection process following the PRISMA guidelines.

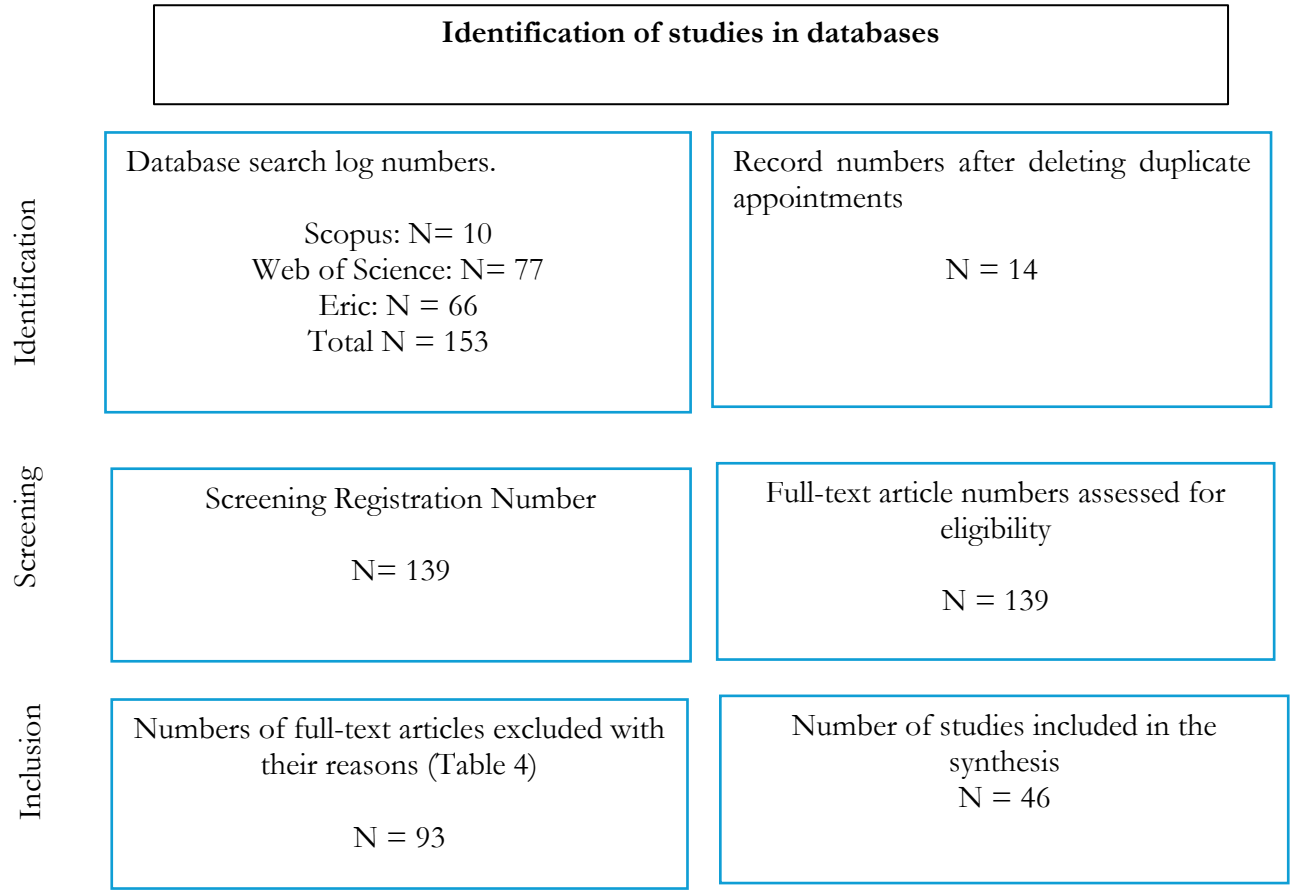

Figure 1. Flowchart of the search and selection process with PRISMA. Source: Own elaboration

3.1. Search

The quality assessment of LMS platforms in university contexts has become a critical field to ensure that these technological tools meet the needs of users. In this context, the quality of LMS platforms can significantly influence students' learning experience and academic efficiency. To address this

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complexity, it is essential to conduct a systematic literature review that identifies and analyzes the most relevant dimensions and criteria in the evaluation of the quality of these platforms.

The keywords that guided the review were those associated with variables, synonyms, and related terms, as shown in (Table 2).

VARIABLES	SYNONYMS/ RELATED TERMS/ KEYWORDS	KEYWORDS
Variable 1: Evaluation	Evaluation, quality	Assessment, quality, evaluation
Variable 2: Platforms	Virtual, digital, educational, learning	E-learning, LMS platforms, online platforms
Variable 3: Higher education	University, Higher Level	University, higher educations

Table 2. Variables and keywords. Source: Authors.

The peer-reviewed articles were searched in the databases: Scopus, WOS and ERIC, using the following search strings (Table 3). In addition, a random review was carried out in each journal, which presented an article in the search, to check that all articles were identified. This first search yielded an initial result of 153 articles. Which, after the elimination of duplicates and screenings, remained in 46 texts.

Databases	*Search strings*
SCOPUS (10)	((TITLE (educational AND platforms) OR TITLE (educational AND platform) OR TITLE (digital AND platform) OR TITLE (digital AND platforms) OR TITLE (lms AND platform) OR TITLE-ABS-KEY (lms AND platforms) AND TITLE-ABS-KEY (e-learning) AND TITLE-ABS-KEY (quality AND assessment) OR TITLE-ABS-KEY (quality AND evaluation) AND TITLE-ABS-KEY (university) OR TITLE-ABS-KEY (higher AND education)) AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar"))
WOS (77)	TI=("educational platform" OR "educational platforms" OR "digital platform" OR "digital platforms" OR "LMS platform" OR "LMS platforms") AND TS=("university") OR TS=("higher education") AND TS=(e-learning) AND TS=("quality assessment" OR "quality evaluation")
ERIC 66	"University" "digital platform" "evaluation" "lms"

Table 3. Search strings for each of the "Scopus", "WOS" and "ERIC" databases. Source: Authors.

3.2. Escanear

This systematic review focused on identifying peer-reviewed empirical journal articles from the indicated databases. Therefore, doctoral theses or any other academic work (TFM, TFG, etc.) were not taken into account, nor were conference proceedings considered. The research team individually reviewed each outcome to ensure that they were all peer-reviewed research articles. In this scanning process, 107 jobs were eliminated.

3.3. Examinar

The research team, individually, reviewed the full text of the 153 articles, identifying whether they met

the inclusion criteria (Table 4). The search was restricted to peer-reviewed scientific articles, ignoring conference proceedings, theses and other dissertations. The research team held three meetings to agree on the inclusion and exclusion criteria and, subsequently, met again on two more occasions to make decisions on certain issues related to certain articles that generated doubts.

This comprehensive review ensured that the assessment of the quality of LMS platforms in HEIs was the main element of the research and not a mere episodic or tangential mention. In this way, 139 articles were evaluated and because they did not deal with quality, 93 were eliminated, leaving the total number of articles collected in this study at 46.

	Inclusion	**Exclusion**
Type of literature	Empirical, peer-reviewed articles in the databases: Scopus, WOS and ERIC	Non-empirical or non-peer-reviewed articles. Articles that are not in the databases listed Other types of academic publications that are not articles (Theses, conference proceedings, etc.)
Context of the systematic review	Assessing the Quality of LMS Platforms in HEIs	Don't Talk About Quality Assessment of LMS Platforms in HEIs
Publication date	De 2018 a 2024 (1er trimesters)	Any date other than the one indicated
Language	English and/or Spanish	Any language other than English and/or Spanish
Data	Identification of dimensions and quality criteria	Does not identify dimensions and criteria for quality assessment

Table 4. Inclusion and exclusion criteria. Source: Authors.

3.3. Synthesize

Throughout the review of the full text of each article, four dimensions and 12 criteria were identified for the evaluation of the quality of LMS platforms in HEIs, and the guiding questions that the articles would answer were generated to include them in each dimension and later, in each criterion (Table 5).

Dimension	**Guiding question D**	**Criterion**	**Guiding question C**
Technique	What features and tools does the platform offer (functionality, security and scalability), for the management, updating and maintenance of the system?	Functionality	Does the platform fulfill the functions necessary for learning and teaching?
		Security and privacy	Is the security of stored and distributed information managed?
		Scalability	Does the platform have the capacity to handle an increase in the number of users and the amount of data without degrading performance?
Pedagogical	What is the support that the platform	Instructional Design	Does it facilitate pedagogical activities and their alignment with contemporary educational theories

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	provides to pedagogical practices and the design of educational content?		and practices?
		Interactivity	What opportunities does the platform offer for interaction between students and teachers, as well as between students?
		Evaluation and feedback	How are evaluations managed and fed back within the platform?
		Content quality	Is the content offered relevant and of quality, does the platform allow users to access, create, organize and manage educational content efficiently?
Usability	What is the capacity, ease and perception with which users can interact with the platform?	Ease of use	Can users navigate easily to develop academic activities?
		Accessibility	Can the platform be used by students with various disabilities?
		User satisfaction	How do users rate the overall experience with the platform?
Administrativa	How do you ensure efficient management of the administrative aspects of a platform?	User Management	Can specific roles and permissions be assigned within the platform?
		Support and maintenance	What is the technical support and training to maximize the effective use of the platform?
		Cost - benefit	What is the relationship between the costs associated with implementing and updating the LMS and the educational benefits?

Table 5. Questions that guide the dimensions and criteria. Source: Authors.

4. RESULTS

4.1. Question 1. What relevant articles indexed in the Scopus, WOS and ERIC databases have been published between 2018 and the first quarter of 2024 on the evaluation of the quality of LMS platforms in HEIs?

The articles selected in the Scopus, WOS and ERIC databases, published between 2018 and the 1st quarter of 2024 on the evaluation of the quality of LMS platforms at the university level, were grouped by dimensions and criteria.

Taking into account the dimensions studied, it is evident that, when addressing this issue, there is a great heterogeneity, among which are: technical, pedagogical, usability and administrative, in this context of the planned systematic review, the existing proposals on the evaluation of the quality of LMS platforms at the university level will be observed.

After performing the eligibility analysis according to the predefined dimensions, 46 articles were finally selected, Figure 2 shows the criteria found in the articles that meet the objectives set.

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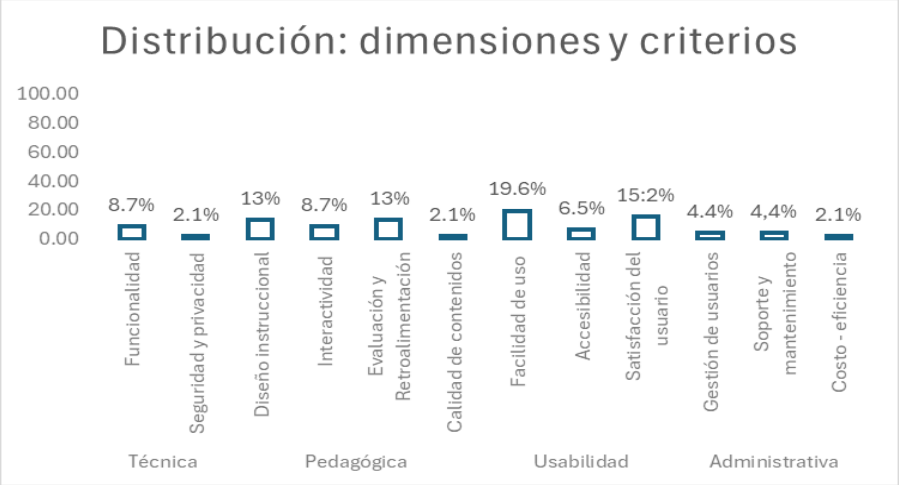

Figure 2. Dimensions and criteria screened for articles. Source: Authors. In original Spanish language

Figure 2 shows that ease of use is the most frequently considered criterion in the studies, representing 19.6% of the articles reviewed, the second most considered criterion is user satisfaction, which appears with 15.2% of the articles, in addition to instructional design and evaluation and feedback are other important criteria with 13% and, Finally, the criteria functionality, interactivity, accessibility, user management, support and maintenance, security and privacy, content quality, cost-efficiency are on a scale of up to 2.1 to 8.7% of the articles reviewed.

4.2. Question 2. What dimensions and criteria are proposed to evaluate the quality of LMS platforms in HEIs?

In this context, the articles were classified and organized in a matrix, where the most relevant information of the 46 articles was included grouped by dimensions, with their respective details, the criteria and the contributions of each one, as can be seen in Table 6.

Dimensions	Criteria	Quantity
Technique	Functionality	4
	Security and privacy	1
Pedagogical	Instructional Design	6
	Interactivity	4
	Evaluation and feedback	6
	Content quality	1
Usability	Ease of use	9
	Accessibility	3
	User satisfaction	7
Administrativa	User Management	2
	Support and maintenance	2
	Cost-efficiency	1
Total		46

Table 6. Distribution, dimensions and criteria. Source: Authors.

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In the 46 selected articles, despite the heterogeneity found, the presence of a number of dimensions that is repeated more frequently is detected, thus the usability dimension was included in 19 articles, while the pedagogical dimension in 17 articles, and the technical and administrative dimension are present in 5 articles each.

The key dimensions and criteria identified and supported by this systematic literature review are presented below.

4.2.1. Technical dimension

N°	ARTICLE	CRITERION	CONTRIBUTION
1	A sustainable quality assessment model for the information delivery in E-learning systems	Functionality	This study examines the quality assessment of learning management platforms (LMS) and proposes a sustainable quality assessment model for LMS from a software perspective based on three key dimensions: system quality, technical quality, and service warmth.
2	Architectures of contemporary digital platforms in education: analysis of exclusion processes	Functionality	This article discusses how digital platform architectures influence exclusion processes and proposes ways to minimize technological impacts to rapidly update curricula and improve students' scientific, technological, and digital skills.
3	Effect of learning management system on Student's performance in educational measurement and evaluation	Functionality	This study looked at two distinct platforms: Moodle, a widely used learning management platform, and AI4ME, a tutorial package specifically designed to provide measurement and assessment mentoring to students. The results of the study showed that the Moodle platform delivered better results in student performance compared to AI4M.
4	Measuring learning outcomes: bridging accreditation requirements and LMS functionalities	Functionality	This study provides a detailed comparison of the functionalities of Canvas, Moodle, and Blackboard, highlighting their capabilities to measure learning outcomes and ensure educational quality. The mechanisms and complements developed facilitate the implementation of quality assurance policies with minimal technical skills.
5	Secure dematerialization of assessments in digital universities through Moodle, WebRTC and safe exam browser (SEB)	Security and Privacy	This recent study has developed a robust security system for the management of assessments, focused on the secure dematerialization of assessments in digital universities. This system integrates Moodle, WebRTC, and secure exam browsers to create a protected and efficient environment.

Table 7. Technical dimension. Source: Authors.

The technical dimension of LMS learning platforms is critical to ensuring a smooth and secure user

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experience. Farid et al., (2018), examined the technical dimension in terms of functionality with a sustainable quality assessment model for LMS platforms, focusing on the quality of the system, service technique, based on the software perspective. In addition, González (2023) analyzed how LMS platform architectures influence exclusion processes and propose ways to minimize technological impacts to quickly update curricula and improve scientific skills. Other authors, such as Oguguo et al. (2021) and El Marsafawy (2022), analyzed different LMS platforms to observe student performance, and how to measure learning outcomes and ensure educational quality. On the other hand, regarding security and privacy, Sylla et al., (2022), have developed a robust security system for the management of assessments, focused on the secure dematerialization of assessments in digital universities.

4.2.2. Pedagogical dimension

N°	ARTICLE	CRITERION	CONTRIBUTION
1	Assessment of qualities of pandemic-driven econtent developed for higher education in India	Quality of educational content	This scientific paper evaluated the quality of electronic educational content and found that most of it was of poor quality compared to established models of instructional designs. Two main factors contributed to this shortcoming: the lack of training for e-content developers and the absence of quality control mechanisms.
2	Educational Platform based on Smartphone to Increase Students' Interaction in Classroom	Interactivity	This scientific work has developed an educational platform in a smartphone-based university environment that uses the Internet of Things (IoT) to increase digital interaction and improve the teaching process during traditional lectures.
3	Building an Educational Platform Using NLP: A Case Study in Teaching Finance	Interactivity	This study has developed an innovative educational platform that combines AI techniques with the experience provided by teachers. This platform automatically collects information from different sources and presents only relevant breaking news, categorized into different subjects and topics.
4	How use of learning management system mediates the relationships between learner interactions and learner outcomes	Interactivity	A recent study has explored how an LMS can measure the relationships between learner interactions and learning outcomes. Although the study revealed several positive effects, it also identified that some of these effects were reduced when considering the impact of higher levels of LMS use. In particular, interactions between students.
5	Exploring the Colombian digital divide using Moodle logs through supervised	Interactivity	This study through the use of Moodle records and supervised learning techniques identifies and proposes a methodology that helps to close the digital divide, considering the geographical location of students and their interaction with an LMS platform.

	learning		
6	Effectiveness of instructional digital platforms in the light of employing simulation models to develop learners' cognitive achievement	Instructional Design	In this study, simulation models were used to analyze the impact of these platforms on students' cognitive performance and strategies were proposed to improve both the quality of didactic content and interaction capabilities in LMS platforms.
7	Predictors of innovation in engineering and postgraduate programs using strategies based on digital platforms	Instructional Design	This study has investigated the predictors of innovation in the educational field through the use of digital platforms, focusing on a variable-by-variable model with high reliability. This model includes key aspects such as logical thinking, methodological and research competence, and the student's previous technical training.
8	Learning behavior, digital platforms for learning and its impact on university student's motivations and knowledge developmen	Instructional Design	The study explores how digital learning platforms influence students' learning behaviors and how these influences affect their motivation and knowledge development through the use of educational apps and virtual classrooms.
9	The King Abdulaziz University COVID-19 e-vaccine: An Evaluation of the Emergency Training Knowledge Model	Instructional Design	This article analyzes learning theories and assessment practices to address contemporary educational challenges. The adaptation of the ETS Model to behaviorist and constructivist theories, as well as to a philosophy of goal-based assessment and decision-making, provides a solid framework for improving the quality of university education.
10	Creative Problem Solving Process Instructional Design in the Context of Blended Learning in Higher Education	Instructional Design	The article addresses blended learning that integrates traditional teaching methods with digital tools, proposes an instructional design based on a comprehensive model that uses the Research and Development (R+D) method to structure and optimize the creative process of problem solving in higher education. The model is based on a series of systematic stages: Analysis, Design, Development, Implementation and Evaluation.
11	A digital learning – teaching platform experienced	Instructional Design	This article examines the implementation and effectiveness of the AYDEP educational platform in the context of digital learning, recommends developing AYDEP focusing on technical,

	during the pandemic: an educational project based on ahi competence (AYDEP)		pedagogical, cooperation and communication elements, technical infrastructure, access and content. It is highlighted that these components are crucial to improve the educational experience and student performance in digital environments.
12	Qualitative Study on the Application of the Assisted Self-Assessment Model Based on the Use of Digital Platforms, in a Pedagogy Course	Evaluation and feedback	This study proposes an assisted self-assessment model that seeks to integrate digital tools with the self-assessment process, providing a structured framework that examines students' assessment of the activities carried out and their perception of the learning process.
13	Virtual Learning Assessment: Practical Strategies for Instructors in Higher Education	Evaluation and feedback	This paper explores several effective online assessment techniques within learning management platforms (LMS). It focuses on the implementation of authentic exams and assessments, such as video demonstrations, group projects, and discussion forums. The collection and use of data within LMSs is analyzed to optimize evaluation strategies.
14	i-Ntervene: applying an evidence-based learning analytics intervention to support computer programming instruction	Evaluation and feedback	This study explores the implementation and effectiveness of the iNtervene LMS platform in the field of computer programming teaching. The platform allows teachers to design, test, and adjust interventions based on learning analytics, with the goal of improving content development and optimizing student learning outcomes in the long term.
15	Confidential Peer-Evaluation as a Method of Learning in Online University Courses	Evaluation and feedback	This study focuses on the use of the Wiki and Test tools within the LMS Blackboard to implement confidential peer assessment, analyzing their impact on learning and the quality of assessments, exploring how these tools improve the quality of student feedback and essay evaluation, as well as the effectiveness of the method in academic training
16	Digitally-mediated Language Assessment Practice (D-LAP): Qualitative Case Studies of Four Thai EFL University Lecturers	Evaluation and feedback	The study explores how university professors in Thailand implement digital assessment practices in the teaching of English as a foreign language (EFL) using the ETS Knowledge Model, examines how these practices relate to behaviorist and constructivist learning theories, and how they influence goal assessment and pedagogical decision-making.

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17	Formative Learning Assessment with Online Quizzing: Comparing Target Performance Grade and Best Performance Grade Approaches	Evaluation and feedback	This study investigates the effectiveness of different grading approaches in formative learning, using online quizzes through the Blackboard LMS platform. The "target performance rating" approach is compared to the "best performing rating" approach to determine which provides more beneficial motivation for student learning and academic development.

Table 8. Pedagogical dimension. Source: Authors.

The pedagogical dimension of LMS platforms is critical to ensure that students not only access information, but also engage in a meaningful learning process. Bhattacharya et al., (2023), evaluated the quality of electronic educational content and found that most of it was of poor quality compared to established models of instructional designs, where the main factors contributed to this deficiency: the lack of training for electronic content developers and the absence of quality control mechanisms. On the other hand, Costley et al., (2022) presented a recent study related to interactivity, which explored how an LMS platform can measure the relationships between learner interactions and learning outcomes, i.e. learners access content and have more meaningful interactions and with regard to learner instructor interaction, the positive effects are partially diminished when the use of the LMS platform is taken into account. The most important aspect is that students interact with the LMS platform rather than direct interaction with instructors and content.

In addition, a smartphone-based LMS platform has been developed that uses the Internet of Things (IoT) to increase digital interaction and improve the teaching process during traditional conferences (AlSubie & Bahri, 2022). Likewise, an innovative LMS platform has been developed that combines artificial intelligence (AI) techniques with the experience provided by teachers, which automatically collects information from different sources and presents only the most relevant, classified into different subjects and topics (Montalvo et al., 2018). In addition, through the use of Moodle records and supervised learning techniques, a methodology that helps close the digital divide is identified and proposed, considering the geographical location of students and their interaction with an LMS platform (Morales et al., 2022).

Incorporating educational simulations and games can make learning more engaging and effective. Almotairi & Elsigini (2022), used simulation models to analyze the impact of these LMS platforms on students' cognitive performance and proposed strategies to improve both the quality of didactic content and interaction capabilities on LMS platforms at um AlQura University. In addition, Mawency et al., (2020), investigated the predictors of innovation in the educational field in engineering and postgraduate programs through the use of PLAD digital platforms from the Francisco de Paula Santander University in Colombia, focusing on a variable model with high reliability. This model includes key aspects such as logical thinking, methodological and research competence, and the student's previous technical training, where the role of the teacher is indispensable in the generation of innovative challenges through virtual training.

On the other hand, Noor et al. (2022), present a study of how LMS platforms influence students' learning behaviors and affect their motivation and knowledge development through the use of educational applications, Bardesi and Garba (2022), analyze learning theories and assessment practices to face contemporary educational challenges at King Abdulaziz University, identifying for the Dean of Electronic and Distance Learning Education (DeLDE) and the adaptation of the Emergency Training Session (ETS) Model to behaviorist and constructivist theories, as well as to a philosophy of goal-based assessment and decision-making, provides a solid framework for improving the quality of university education. Nurrijal et al. (2023) address the Creative Problem Solving (CPS) process, which offers a structured methodology to improve the critical, creative and innovative thinking skills of each student,

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that is, through blended learning, traditional teaching methods are integrated with digital tools, an instructional design based on a comprehensive model that uses the Research and Development (R+D) method is proposed. The model is based on a series of systematic stages: analysis, design, development, implementation and evaluation, where the learning design is valid, practical and effective in improving the thinking skills of future teachers.

Good instructional design implies a clear and logical structure in the courses. This helps students navigate the content effectively and understand how different topics are related. Sarica (2022) examines the implementation and effectiveness of the AYDEP LMS platform in the context of digital learning, at the Kırşehir Ahi Evran University in Turkey, it is recommended to develop AYDEP focused on elements: technical, pedagogical, cooperation and communication, technical infrastructure, access and content. It is highlighted that these dimensions are crucial to improve the educational experience and student performance in digital environments.

LMS platforms should offer different types of assessments (exams, projects, self-assessments) to measure student progress holistically. This allows assessing not only knowledge, but also practical and critical skills, Denton & Simmons (2021), explore various effective online assessment techniques within LMS platforms, focus on the implementation of authentic exams and assessments, such as video demonstrations, group projects, and discussion forums. Mann (2014) discusses the collection and use of data within LMS platforms to optimize assessment strategies and rapid and supportive feedback is critical. In addition, Rioseco & Philominraj (2019), proposes an assisted self-assessment model based on the use of digital platforms that seeks to integrate digital tools with the self-assessment process, providing a structured framework that examines the assessment of students regarding the activities carried out and their perception of the learning process, the proposed model, although it is easy to implement, it entails a change in the classic way of evaluating, since it modifies the way in which value is assigned to activities and learning, in itself.

Lemaire et al., (2022), focus on the use of the Wiki and Test tools within the LMS Blackboard platform to implement confidential peer assessment, analyzing their impact on learning and the quality of assessments, exploring how these tools improve the quality of student feedback and essay assessment, as well as the effectiveness of the method in academic training (Adachi, Tai & Dawson, 2018). On the other hand, Imsa-Ard & Tangkiengsirisin (2023), explore how university professors in Thailand implement digital assessment practices (D-LAP) in the teaching of English as a foreign language (EFL) using the Knowledge Model (ETS), examine how these practices relate to behaviorist and constructivist learning theories, and how they influence goal assessment and pedagogical decision-making. On the other hand, Lubrick & Wellington (2022), investigate the effectiveness of different grading approaches in formative learning, using online questionnaires through the LMS Blackboard platform, the "target performance rating" (TPG) approach is compared with the "best performing rating" (BGP) approach to determine which provides more beneficial motivation for student learning and academic development, where TPG outperformed the BPG cohort in the three main summative measures of course performance (midterm MCQ exam, final MCQ exam, final written question). In addition, it is essential to have an LMS evaluation platform, which is why Utamachant, Anutariya & Pongnumkul (2023), explore the implementation and effectiveness of the iNtervene LMS platform in the field of computer programming teaching. The platform allows teachers to design, test and adjust interventions based on learning analysis, with the aim of improving content development and optimizing student learning outcomes in the long term and to be able to improve the identification of at-risk students and provide more informational support to select intervention approaches.

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4.2.3. Usability dimension

N°	ARTICLE	CRITERION	CONTRIBUTION
1	Between accessibility and adaptability of digital platform: investigating learners' perspectives on digital learning infrastructure	Accessibility	This article explores the importance of accessibility and adaptability in digital learning platforms, with a particular focus in the context of the health crisis. It examines how these technological features affect the student experience and contribute to the success of online learning. The need to continuously improve accessibility and digital adaptability to optimize the educational experience and the achievement of learning objectives is highlighted.
2	Evaluation of usability in Moodle Learning Management System through Analytics Graphs: University of Applied Sciences Teacher's perspective in Finland	Accessibility	This study provides a detailed look at the usability assessment of Moodle, a widely used LMS, through the use of analytical graphs. The importance of this usability is emphasized, underlining that an intuitive and well-designed platform can save time and effort, allowing teachers to focus more on teaching and less on technical administration.
3	Students' acceptance and perceptions of online assessments post- COVID-19 pandemic: A case of Community Extension students at a historically disadvantaged institution	Accessibility	This study investigated the acceptance and perceptions of community outreach students in a historically disadvantaged institution regarding online assessments, specifically using Microsoft Teams. This analysis sheds light on the challenges and opportunities faced by these students and suggests measures to improve the experience and maintain academic integrity.
4	Factors determining satisfaction with e-learning during the pandemic in the opinion of Polish and Spanish students: analysis of differences and similarities	User satisfaction	This article analyzed the factors that determine satisfaction with eLearning from the perspective of Polish and Spanish students. By focusing on the use of digital teaching materials, the quality of platforms, the organization of eLearning and the support of universities and teachers, student satisfaction can be improved. Cultural and contextual differences should also be considered when designing eLearning programs, ensuring that they are inclusive and adaptable.
5	Analysis of the perception of teachers, users of an educational platform through the TPACK,	User satisfaction	This work evaluated teachers' perception of the educational benefits of the Blackboard LMS platform using the TPACK (Technological Pedagogical Content Knowledge), SAMR (Substitution, Augmentation, Modification, Redefinition) and TAM3 (Technology

	SAMR and TAM3 models in a higher education institution		Acceptance Model 3) models. The findings of the study highlight the need for comprehensive training in technological, pedagogical and curricular aspects, as well as the importance of adequate infrastructure and changes in institutional policies.
6	Attitude of University Students to the Information Content of Electronic Educational Platforms	User satisfaction	This study has analysed the attitude of university students towards the information and content available on electronic educational platforms. The findings indicate a high level of satisfaction with the convenience and accessibility that these platforms offer, as well as with the ability to review material and lectures repeatedly. However, students have also pointed out a noticeable lack in the practical component of online courses.
7	The Disruption of the Face-to-Face to the Virtual. Perceptions of Teaching Directors on the Use of Digital Platforms in the Context of a Pandemic at a University in Northern Chile	User satisfaction	This article analyzes the perceptions of teaching directors about the use of digital platforms during the pandemic in a university in northern Chile. The study characterizes the disposition and problems faced by academics when moving their face-to-face classes to virtuality and highlights a differentiated use of digital technologies according to the age groups of the teachers.
8	Digital Platforms in the Emergency Remote Education: the Students' Preferences	User satisfaction	This article addresses a crucial aspect for online learning, focusing on the needs and preferences of students in relation to the digital platforms used for language learning: Blackboard and Zoom. The results show a clear preference of students for Zoom. This preference is based on the ease of use, compatibility, and availability of an app with smartphones
9	Investigating students' satisfaction in online learning: the role of students' interaction and engagement in universities	User satisfaction	This study explores student satisfaction with the use of virtual platforms, the interaction between students and teachers. It is highlighted that Microsoft Teams is the best digital platform in terms of facilitating interaction between students and teachers, based on several aspects that influence student satisfaction and academic engagement: interaction between students and teachers, student engagement.
10	The Evaluation of User Experience of Learning Management Systems Using UEQ	User satisfaction	The article concludes that user experience assessment is essential for the development and improvement of learning management systems. By integrating both pragmatic and hedonic aspects into the design of these platforms, a more satisfying and effective experience can be achieved for users. The need for a holistic approach that considers usability and emotional experience to maximize the educational potential of LMSs is emphasized.

11	Exploring the Mediator in Science Service Learning: Analysis of University Students' Behavioural Intention to Use Digital Platforms	Ease of use	The study analyzes the use of digital platforms in the university context based on the Technology Acceptance Model (TAM). The analysis focuses on identifying the key mediators that affect university students' acceptance and use of digital platforms in scientific service learning, utility perception, ease of use, and attitude towards technology.
12	Uses of digital platforms in Higher Education from the perspectives of the educational research	Ease of use	The study offers a comprehensive view of how digital technologies are transforming the educational landscape in universities. It identifies the most used and emerging digital platforms in higher education and presents a proposal for strategies for their implementation that can serve as a guide for universities seeking to improve their teaching methods and adapt to current demands.
13	The value of postgraduate students opinions in the quality management of academic e-learning	Ease of use	The study explores how student perceptions can influence the continuous improvement of e-learning programs in higher education institutions. The results of the study show that, although most of the aspects of e-learning examined are perceived positively, there is always room for improvement, in relation to the diversification of teaching materials, improved communication, personalized feedback, optimization of the platform, among other aspects.
14	Effects of instructors' academic disciplines and prior experience with learning management systems: A study about the use of Canvas	Ease of use	The study examines how instructors' prior experience with LMS Canvas and their academic discipline influence the use and effectiveness of the system. This analysis seeks to identify differences in Canvas adoption and management based on these factors and provide recommendations to improve instructor training and support. By proposing training tailored to different levels of experience and needs, universities can significantly improve the adoption and effective use of LMS, thus contributing to more efficient and enriching teaching.
15	Student teachers' experiences of the emergency transition to online learning during the covid-19 lockdown at a south African university	Ease of use	The study was based on the TAM in relation to students' opinions on digital equity and access to technology. The need to continue improving technological and support infrastructure to ensure that all students have equitable access to education in the future is emphasized
16	Towards integrating quality in theoretical models of acceptance: An extended proposed model applied to e-learning services	Ease of use	The article concludes that integrating quality into UTAUT models can offer a more complete understanding of the factors that influence the use of e-learning platforms. The need for a holistic approach that considers both technology and user experience to improve the effectiveness of learning in digital

			environments is emphasized.
17	An evaluation of the impact of confinement on the quality of e-learning in higher education institutions	Ease of use	This study has explored the impact of e-learning platform quality, using TAM in three dimensions: service quality from an IT, administrative and learning perspective. It is concluded that there is a significant positive relationship between the perceived usefulness of the e-learning platform and the benefits experienced by users.
18	Investigating computer science students' intentions towards the use of an online educational platform using an extended technology acceptance model (e-TAM): An empirical study at a public university in Tunisia	Ease of use	The article concludes that the Extended Technology Acceptance Model (e-TAM) is effective in understanding the intentions of using online educational platforms among computer science students. The importance of improving the perception of usefulness and ease of use of platforms is emphasized, as well as of fostering a positive attitude towards educational technologies.
19	Brazilian's perspective about adoption intention and effectiveness of digital platforms for online learning during COVID-19	Ease of use	The authors conclude that offering a digital teaching platform with resources that allow high interaction between students and instructors and that do not imply high costs for students can help increase the willingness to use the platform. In addition, it is suggested to pay attention to inequalities in access to technology to ensure that all students have equitable opportunities in their education.

Table 9. Usability dimension. Source: Authors.

The massive expansion of LMS platforms has been responsible for the widespread progressive engagement created between students and educators, due to the disparity in the availability of digital infrastructure between rural and urban areas. Huda (2024), examine the importance of accessibility and adaptability in LMS platforms, with a particular focus in the context of the health crisis. It explores how these technological features affect the student experience and contribute to the success of online learning, i.e. highlights the need to continuously improve accessibility and digital adaptability to optimize the educational experience and the achievement of learning objectives. Ndlovu, Gumede, & Mthimkhulu (2023), investigated student acceptance and perceptions, using the Technology Acceptance Model (TAM) as a theoretical framework to examine the acceptance of online assessments and identify barriers to their adoption in a community extension in a historically disadvantaged institution with respect to online assessments, specifically using the LMS Microsoft Teams platform. This analysis sheds light on the challenges and opportunities faced by these students and suggests measures to improve the experience and maintain academic integrity, mitigate technical challenges, provide training and support to reduce anxiety among students caused by assessments. On the other hand, Olaleye et al., (2023), take a detailed look at the usability assessment of Moodle, a widely used LMS platform, through the use of analytical graphs. The importance of this usability is emphasized, underlining that an intuitive and well-designed LMS platform can save time and effort, allowing teachers to focus more on teaching and less on technical management.

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User satisfaction when using an LMS platform is a fundamental aspect that influences the effectiveness of online learning, it is a multifaceted process that involves understanding their needs, perceptions, attitudes and the factors that influence their experience, where measuring and evaluating these aspects is crucial to improve the LMS platform and online learning. Krylova & Levashov (2022) have analyzed the attitude of students at several Russian universities to the information and content available on LMS platforms. The findings indicate a high level of satisfaction with the convenience and accessibility that these platforms offer, as well as with the ability to review material and lectures repeatedly. However, students have also pointed out a noticeable lack in the practical component of online courses. On the other hand, Hummaira et al (2023), explore student satisfaction with the use of LMS platforms, the interaction between students and teachers. It is highlighted that Microsoft Teams is the best LMS platform in terms of facilitating interaction between students and teachers, based on several aspects that influence student satisfaction and academic engagement: interaction between students and teachers, student engagement. Al Shammari (2021), address a crucial aspect for online learning, focused on the needs and preferences of students in relation to the LMS platforms used for language learning: Blackboard and Zoom. The results show a clear student preference for Zoom, this preference is based on ease of use, smartphone compatibility, and the availability of a smartphone app. Another important aspect is the factors that determine user satisfaction (Marciniak & Rembielak, 2022), from the perspective of Polish and Spanish students, by focusing on the use of digital teaching materials, the quality of platforms, the organization of e-learning and the support of universities and teachers, student satisfaction can be improved, Cultural and contextual differences should also be considered when designing e-learning programs, ensuring that they are inclusive and adaptable. It is also important to see the perception of teachers, Samperio & Barragán (2018), evaluated the educational benefits of the LMS Blackboard platform using the TPACK (Technological Pedagogical Content Knowledge), SAMR (Substitution, Augmentation, Modification, Redefinition) and TAM3 (Technology Acceptance Model 3) models, the findings of the study highlight the need for comprehensive training in technological aspects, pedagogical and curricular policies, as well as the importance of adequate infrastructure and changes in institutional policies. The differentiated use of digital technologies according to the age groups of teachers is also pointed out (Rivera, Sánchez & Cortes (2021). On the other hand, to understand and improve user satisfaction, it is important to measure and evaluate different aspects, Saleh et al., (2022), analyze the evaluation and measurement based on the user experience of an LMS platform, as the design of the platform moves from being technology-centric to user-centric, developers must prioritize user experience (UX). The LMS platform, as part of an e-learning system, can benefit from UX research to measure ease of use and user satisfaction. Academic institutions around the world prefer to use their own custom LMS platform. On the other hand, these studies only partially consider LMS products, instead of looking at the quality of LMSs, conducted a study focused on comparing LMSs and raising awareness, most participants were satisfied with Moodle's efficiency, attractiveness, and clarity. Therefore, Moodle should be designed by UI design experts and UX professionals, and then Moodle users could positively evaluate the UX.

Ease of use is a critical factor in the success of an LMS platform; Mou et al., (2023), analyze the use of LMS platforms in the Taiwanese university context based on the TAM, focus on identifying two mediators that affect the acceptance and use of digital platforms by university students in learning: perceived usefulness and perceived ease of use. The findings of this research provide some suggestions for improving students' behavioral intention. Several factors can influence the ease of use of an LMS platform, Malanga et al., (2022), conclude that integrating quality into Unified Theory of Acceptance and Use of Technology (UTAUT) models, can offer a more complete understanding of the factors that influence the use of LMS platforms. The need for a holistic approach that considers both technology and user experience to improve the effectiveness of learning in digital environments is emphasized. On the other hand, users' perception of the ease of use of LMS platforms can influence their adoption and satisfaction. Rembielak & Marciniak (2021), explore how student perceptions can influence the continuous improvement of online programs in HEIs. The results of the study show that, although most

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of the aspects examined of online education are perceived positively, there is always room for improvement, in relation to the diversification of teaching materials, improved communication, personalized feedback, optimization of the LMS platform, among other aspects. In addition, users' opinion on the ease of use of the LMS platform can provide valuable feedback to improve it, Maphalala, Khumalo, & Khumalo (2021), conduct a study with TAM in relation to students' opinions on digital equity and access to technology on LMS platforms. The need to continue improving technological and support infrastructure to ensure that all students have equitable access to education in the future is emphasized.

Dos Santos et al., (2022), conclude that offering an LMS platform with resources that allow high interaction between students and instructors and that do not imply high costs for students can help increase the willingness to use the platform. In addition, it is suggested to pay attention to inequalities in access to technology to ensure that all students have equitable opportunities in their education, in addition to this the intention of users to use the LMS platform may be influenced by its ease of use, Adouani & Khenissi (2024), uses the proposed Extended Technology Acceptance Model (e-TAM). The findings contribute to the literature by validating an extension of TAM in the Tunisian context and providing valuable information for educators, policymakers, and LMS platform developers to improve their design, usability, and effectiveness.

On the other hand, to assess the impact of quality on LMS platforms, the dimensions can be established and several indicators can be used. Rughoobur-Seetah & Hosanoo (2021), analyze the impact of the quality of LMS platforms, using TAM in three dimensions: quality of service from an IT, administrative, and learning perspective. It is concluded that there is a significant positive relationship between the perceived usefulness of the LMS platform and the benefits experienced by users. The administrative management of an LMS platform is essential to ensure its efficient operation and its ability to meet the needs of students and teachers.

4.2.3. Administrative dimension

N°	ARTICLE	CRITERION	CONTRIBUTION
1	Factors determining satisfaction with e-learning during the pandemic in the opinion of Polish and Spanish students: analysis of differences and similarities	User Management	The article makes a significant contribution to the field of eLearning by proposing a comprehensive model that assesses the quality of online education platforms. That is, it is based on the integration of various perspectives and dimensions, with the aim of providing a thorough and detailed evaluation of the entire educational process. The main dimensions identified are: technical, administrative and educational. It differs from other approaches by evaluating all phases of the eLearning process, from initial preparation to final evaluation of the model.
2	The identity changes in online learning and teaching: instructors, learners, and learning management systems	User Management	The study addresses identity shifts in online learning and teaching, focusing on the transformation of three key components: instructors, learners, and LMSs. This analysis is critical to understanding how the identities of these actors adapt and evolve in the context of online education, and how these changes can be effectively integrated to improve the educational experience. These changes include roles and responsibilities and interaction and communication.

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3	Transforming universities in interactive digital platform: case of city university of science and information technology	Support & Maintenance	The article concludes that digital transformation is a crucial process for universities looking to stay relevant in an ever-changing educational environment. Creating interactive digital platforms not only enhances the learning experience, but also prepares students to face the challenges of the future of work.
4	Effect of Convergence Curriculum using Machine Learning Educational Platform on Artificial Intelligence Teaching Efficacy of Pre-Service Teachers	Support & Maintenance	The article concludes that the implementation of a convergence curriculum using machine learning platforms has a positive effect on the training of teachers in the field of artificial intelligence. This approach not only improves the effectiveness of teaching, but also prepares future educators to meet the challenges of education in an ever-evolving technological environment.
5	Fuzzy Vikor Application for Learning Management Systems Evaluation in Higher Education	Cost-efficiency	The article concludes that the application of the VIKOR method, adapted to handle fuzzy information, is a useful tool to evaluate and improve LMSs in higher education. By integrating quality into the decision-making process, more informed decisions can be made that benefit both students and teachers in their educational experience.

Table 10. Administrative dimension. Source: Authors.

User management is critical to the success of any LMS platform; Kwon et al. (2021), addressing identity shifts in online learning and teaching, focuses on the transformation of three key components: instructors, learners, and LMSs. This analysis is critical to understanding how the identities of these actors adapt and evolve in the context of online education, and how these changes can be effectively integrated to improve the educational experience. These changes include roles and responsibilities and interaction and communication. On the other hand, Ortiz et al., (2021), propose a comprehensive model that evaluates the quality of LMS platforms. This model is based on the integration of various perspectives and dimensions, with the aim of providing a thorough and detailed assessment of the entire educational process. The main dimensions identified are: technical, administrative and educational. It differs from other approaches by evaluating all phases of the e-learning process, from initial preparation to final evaluation of the model.

The administration of LMS platforms also involves a series of tasks and responsibilities to ensure the correct operation and maintenance of these systems, a combination of technical, user and content management tasks, and continuous improvement to ensure an effective and satisfactory online learning experience for all involved. Habib et al. (2021), conduct a study to understand and evaluate the digitalization of the entire education system at the Municipal University of Information Science and Technology (CUSIT) Pakistan. It is concluded that the success of technological adaptation in HEIs depends on the integrating effort of management, teachers and students, emphasizing the importance of automation of HEIs, for quality education. In addition, this study supports and recommends that an ICT-driven infrastructure be established to meet the needs of the current era and take advantage of technological advances.

In addition, LMS platform management is not only focused on the technical and organizational part,

but it is also crucial to consider the cost and efficiency of these tools; Ayouni et al. (2021), apply the VIKOR method, adapted to handle diffuse information, it is a useful tool to evaluate and improve LMS platforms in HEIs, by integrating quality into the decision process, more informed decisions can be made that benefit both students and teachers in their educational experience.

4. CONCLUSIONS

The quality assessment of LMS platforms in university contexts represents a significant challenge in the HEI field. Through various studies, it has become clear that, despite the growing interest and scientific production around LMS platforms, there is no single and consensual approach to their quality assessment.

The exhaustive study of the quality assessment of LMS platforms has revealed that the quality of these tools depends on a balanced combination of several dimensions: the pedagogical one, is crucial for LMS platforms to facilitate the implementation of innovative teaching-learning strategies, encourage interaction and collaborative work between students and teachers, and allow an effective assessment of students' progress and achievements. The technique determines that LMS platforms are stable, secure, compatible with multiple devices and easily integrable with other educational tools and resources. Usability also plays a fundamental role, since an intuitive and easy-to-navigate interface, together with accessibility features, guarantee a satisfactory experience for all users. Finally, the administrative one establishes that LMS platforms offer efficient management tools for the creation and organization of courses, student enrollment, progress tracking, and reporting. Only when these four dimensions are effectively combined can LMS platforms become truly valuable tools for improving the quality of education in today's digital environment.

In light of the findings made on the key dimensions that determine the quality of LMS platforms, several promising lines of research are opened for the future, it can be recommended that a future line of research should focus on the customization of the dimensions and evaluation criteria: technical, pedagogical, usability and administrative, for which they should focus on the development of evaluation instruments for each dimension, that considers the specific needs of each institution and comprehensively addresses the dimensions and allows the quality of LMS platforms to be assessed, in order to contribute significantly to the improvement of education in the digital environment.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest regarding the research, authorship and/or publication of this article.

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