International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 08 , August - 2026

Learning Management Systems in Higher Education A Multidimensional Analysis of Technologies, Adoption, and Innovation

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Abstract - Learning Management Systems (LMSs) have become a core part of higher education because they bring course content, communication, assessment, learner support, and academic information into a common digital environment. This survey examines LMS development from traditional classroom practices and computer-assisted learning to web-based, cloud-based, and artificial intelligence-enabled platforms. The review also considers the major theories used to explain LMS adoption, the needs of students, instructors, administrators, and institutions, and the functional components that determine platform usefulness. Particular attention is given to learning analytics, adaptive learning, mobile access, gamification, interoperability, privacy, accessibility, and artificial intelligence. The literature indicates that LMS effectiveness is not determined by technology alone. User acceptance, instructional design, institutional support, digital skills, infrastructure, and responsible data practices strongly influence outcomes. Recent work also shows a shift from LMSs as content repositories toward intelligent learning ecosystems capable of supporting personalization and data-informed decision making. Based on the reviewed literature, the paper identifies continuing gaps in evidence about long-term learning outcomes, responsible AI integration, accessibility, cross-platform interoperability, and context-sensitive adoption. The review concludes with future directions for learner-centered, secure, inclusive, and intelligent LMS ecosystems.

Keywords: Learning Management Systems, Higher Education, E-learning, Technology Adoption, Learning Analytics, Artificial Intelligence, Adaptive Learning, Digital Transformation

I. INTRODUCTION

Imagine a university student preparing for an examination while travelling home. The student opens the university LMS on a mobile phone and finds lecture notes, recorded classes, assignments, quizzes, announcements, and grades in one place. The instructor can simultaneously upload resources, evaluate work, communicate with students, and monitor progress. This everyday situation shows why LMS platforms have moved from optional digital tools to important parts of higher-education infrastructure.

An LMS is an integrated software environment used to manage learning content, communication, assessment, and learner activity [1], [2]. Its development has followed the wider growth of educational technology, moving from computer-assisted instruction to web-based learning, cloud services, mobile access, analytics, and intelligent systems [3], [4]. Modern platforms therefore combine educational and administrative functions rather than simply storing lecture files.

The value of an LMS depends on more than the availability of technical features. System quality, information quality, service quality, learner characteristics, instructor support, and perceived usefulness all influence successful e-learning [5]. Institutional policy is also important because LMS environments handle accounts, courses, assessment information, ownership, support, usage, and protection of data [6]. The rapid shift toward online and blended learning has therefore made questions of adoption, governance, accessibility, and responsible data use as important as technical capability.

This survey brings these dimensions together. It examines LMS evolution, architecture, adoption theories, stakeholder perspectives, platform comparison, implementation challenges, emerging technologies, and future research. The aim is to provide a single, accessible view of the LMS ecosystem for researchers, teachers, administrators, and institutions.

Figure 1 summarizes the central argument of this survey. Technological evolution, adoption models, stakeholder needs, and institutional conditions shape the core LMS functions. These functions increasingly connect with emerging technologies, while challenges such as privacy, infrastructure, accessibility, and user resistance influence the final educational outcomes.

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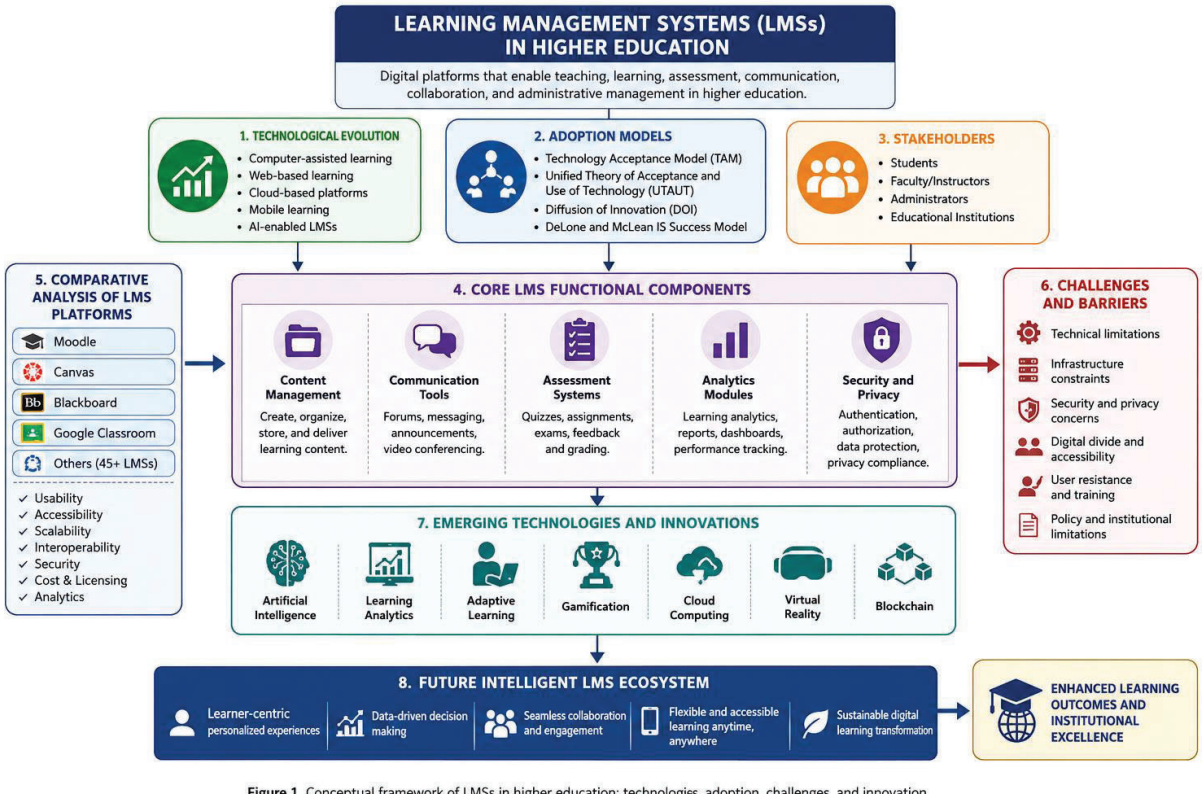

Fig.1. Conceptual framework illustrating the multidimensional LMS ecosystem in higher education.

II. EVOLUTION OF LEARNING MANAGEMENT SYSTEMS

The evolution of LMSs can be understood as a progression from physical classrooms toward connected and increasingly intelligent learning ecosystems. Traditional learning depended on face-to-face teaching, printed materials, fixed schedules, and physical access to instructors and libraries. Computer-assisted learning introduced programmed instruction, interactive exercises, and computer-based feedback. The PLATO system is an important early example of networked computer-supported instruction [7], [8]. As the internet expanded, e-learning environments enabled remote access, online communication, electronic submission, and asynchronous learning [9], [10]. Cloud computing then improved scalability and reduced the need for institutions to maintain all computing resources locally [11], [12]. More recently, AI and learning analytics have enabled personalized recommendations, predictive support, intelligent assistance, and adaptive learning [13], [14]. The result is a shift from static content delivery toward flexible, data-informed, and learner-centered digital education.

III. RESEARCH METHODOLOGY

This study uses a structured literature review approach. Literature was identified from major scholarly sources including Scopus, Web of Science, IEEE Xplore, Science Direct, Springer Link, Wiley Online Library, and Google Scholar. Search terms combined concepts such as Learning Management Systems, Higher Education, E-learning, LMS adoption, Learning Analytics, Artificial Intelligence, Cloud Computing, and Online Learning. Priority was given to peer-reviewed studies, established books, review papers, and influential foundational works, while older sources were retained when they provided important theoretical or historical foundations [15]–[18].

Studies were included when they directly addressed LMS use or closely related digital learning environments in higher education and provided useful evidence on technology, adoption, architecture, stakeholders, analytics, emerging technologies, or implementation. Duplicate, irrelevant,

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inaccessible, and non-scholarly records were excluded. For each selected study, information on publication year, research purpose, context, methodology, LMS type, adoption factors, challenges, technologies, and major findings was extracted. The evidence was then synthesized into the themes used throughout this paper. This approach follows established guidance for transparent literature reviews and systematic evidence synthesis [15]–[18]. The review process moves from literature identification to screening, extraction, thematic synthesis, and research outcomes. The study is described as structured rather than claiming a fully reported PRISMA systematic review because exact record counts and screening statistics are not available in the present dataset.

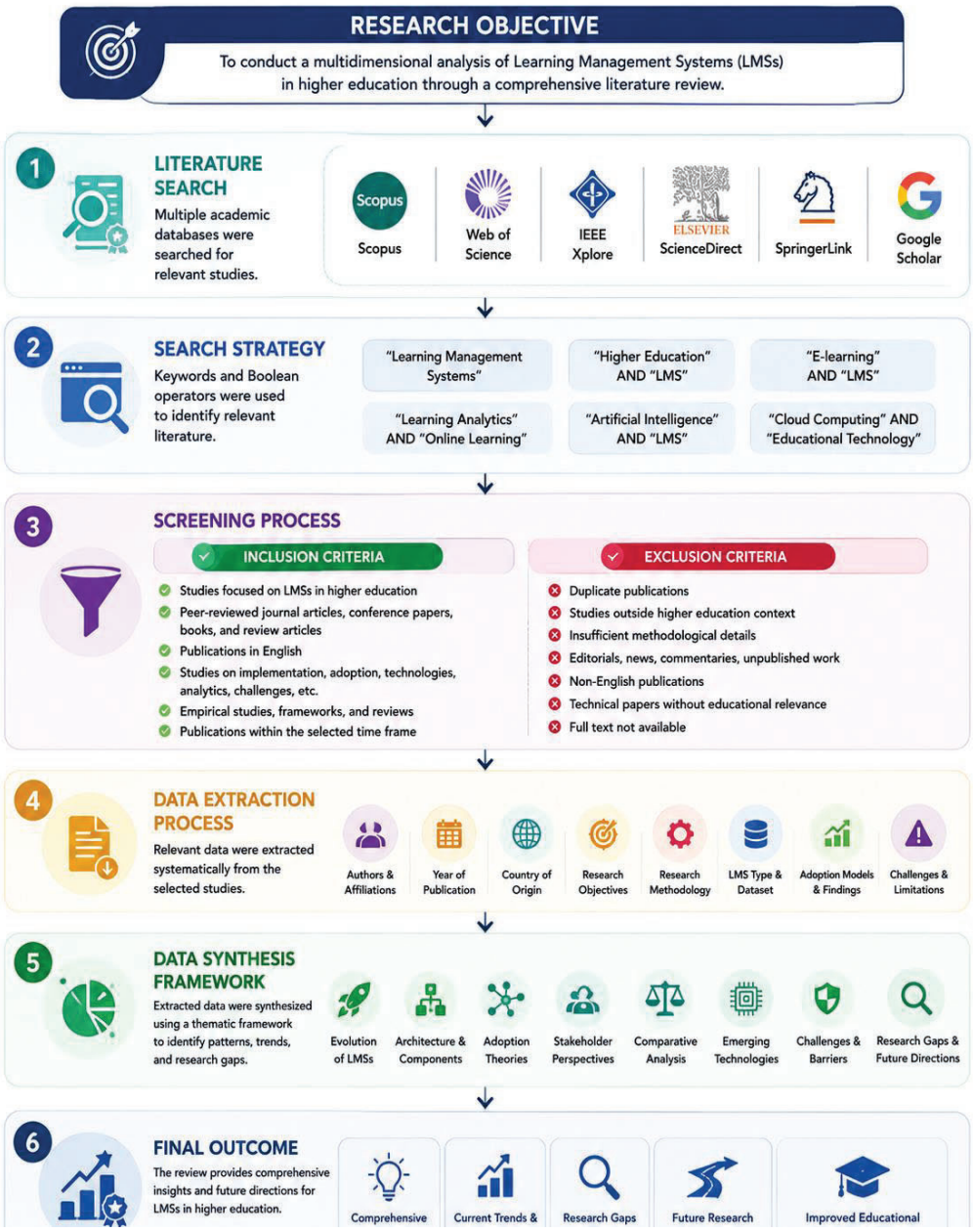

Fig.2 . Structured literature review workflow used for the study.

International Journal of Engineering Research & Technology (IJERT)
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Vol. 15 Issue 08 , August - 2026

IV. ARCHITECTURE AND CORE COMPONENTS OF LEARNING MANAGEMENT SYSTEMS

A modern LMS connects users, content, communication, assessment, analytics, external applications, and institutional services. Its effectiveness comes from how these components work together rather than from any single feature [1], [2]. User and access management controls roles and permissions; content management organizes notes, videos, links, and other learning resources; communication tools support forums, announcements, messaging, and live interaction; and assessment modules handle quizzes, assignments, grading, and feedback. Learning analytics converts activity data into information about engagement and progress, while interoperability connects the LMS with student information systems, digital libraries, examination tools, and external learning applications [3], [19]. Security and privacy mechanisms protect student identities, grades, submissions, and activity records, while institutional policies define responsible use [6]. Mobile and accessibility support extend learning to different devices and learners. Together these functions create a cycle in which content supports interaction, interaction produces learning activity, assessment provides evidence, analytics generates insight, and feedback supports improvement.

Fig.3. Functional architecture illustrating the core components of learning management systems in higher education.

V. TECHNOLOGY ADOPTION AND ACCEPTANCE MODELS

Whether an LMS succeeds depends strongly on whether students and instructors are willing and able to use it. The Technology Acceptance Model (TAM) proposed by Davis explains acceptance mainly through perceived usefulness and perceived ease of use [20]. In simple terms, users are more likely to use an LMS when they believe it helps them accomplish their academic work and does not feel unnecessarily difficult. UTAUT extends this view by considering performance expectancy, effort expectancy, social influence, and facilitating conditions [21]. Diffusion of Innovation theory adds the wider institutional context by considering characteristics such as relative advantage, compatibility, complexity, treatability, and observability [22]. The DeLone and McLean model is useful when the focus is broader system success because it links system quality, information quality, service quality, use, satisfaction, and net benefits [23]. LMS studies commonly use these models because adoption is influenced by both individual perceptions and organizational conditions. Evidence from Moodle research also indicates that technological, social, human, and reinforcement factors can shape adoption [24].

VI. STAKEHOLDER PERSPECTIVES

LMS implementation affects several groups, and their expectations are not always the same. Students generally value easy access, clear navigation, mobile support, reliable communication, timely feedback, and useful learning resources. Instructors need efficient course creation, assessment, grading, communication, and analytics without excessive administrative work. Administrators focus more on scalability, integration, security, cost, governance, and institutional reporting. Successful implementation therefore requires stakeholder involvement rather than treating the LMS as a purely technical purchase. Research on human factors and LMS implementation shows that confidence, support, training, and involvement can influence effective use [25], [26]. A platform that is technically powerful but difficult for instructors or students to use may produce limited educational value.

VII. COMPARATIVE ANALYSIS OF LMS PLATFORMS

There is no single LMS that is ideal for every institution. Platform selection depends on institutional size, budget, technical expertise, teaching model, integration needs, accessibility, security, and desired level of customization. Recent comparative work evaluated 45 LMS platforms using software-quality and teaching-learning criteria and showed substantial variation among platforms [3]. Open-source systems such as Moodle offer extensive customization and control, while commercial platforms such as Canvas and Blackboard emphasize managed services, institutional support, and integrated ecosystems. The practical lesson is that institutions should select a platform according to educational and organizational requirements rather than popularity alone [27], [28].

TABLE 1. HIGH-LEVEL COMPARISON OF COMMON LMS CHARACTERISTICS.

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Dimension	Moodle	Canvas	Blackboard	Institutional Priority
Customization	High	Moderate	Moderate	Match local needs
Ease of use	High with setup	High	High	User experience
Integration	Extensive	Extensive	Extensive	Interoperability
Analytics	Available	Strong	Strong	Data-informed teaching
Cost model	Flexible/open-source	Commercial	Commercial	Total cost of ownership

VIII. CHALLENGES AND BARRIERS

LMS implementation can fail or underperform when technical and human issues are treated separately. Common barriers include inadequate internet connectivity, limited hardware, insufficient digital skills, poor training, resistance to change, complicated interfaces, accessibility gaps, privacy risks, cyber security concerns, and weak institutional policies [6], [24], [25]. The digital divide is especially important because a platform cannot provide flexible learning if students cannot reliably access devices or connectivity. Data-intensive and AI-enabled LMSs also increase the importance of transparency, data governance, consent, and secure handling of learner information. Consequently, successful implementation requires continuous training, technical support, clear governance, inclusive design, and regular evaluation rather than a one-time software deployment.

IX. EMERGING TECHNOLOGIES AND INNOVATION

The next generation of LMS platforms is being shaped by artificial intelligence, learning analytics, adaptive learning, mobile technologies, gamification, virtual and augmented reality, cloud computing, and connected educational applications. AI can support chat-based assistance, content recommendation, automated feedback, prediction of learner risk, and personalized learning pathways [13], [14]. Learning analytics can help instructors understand engagement and identify students who may need support, although evidence for direct improvement in academic achievement remains mixed and stronger evaluation is needed [29]. Adaptive learning systems can adjust activities to learner progress, while gamification can add feedback and motivational elements. Immersive technologies may support simulations and experiential learning in fields where practice is important. Recent reviews also show growing interest in AI-enabled LMS applications, but they emphasize the need to balance innovation with ethics, privacy, transparency, and educator oversight [30].

X. RESEARCH GAPS AND FUTURE DIRECTIONS

Several gaps remain despite the large volume of LMS research. First, many studies measure acceptance or short-term engagement rather than long-term learning outcomes. Second, adoption models are often tested within a single institution or country, making cross-cultural and cross-institutional comparisons difficult. Third, AI-enabled LMS research is developing rapidly, but evidence about reliable educational benefits, bias, explainability, academic integrity, and responsible use is still developing [30]. Fourth, accessibility and the needs of learners with different abilities require more attention in platform evaluation. Fifth, interoperability and data governance become increasingly important as institutions connect multiple educational tools. Future research should therefore combine technical evaluation with pedagogical evidence, stakeholder experience, privacy analysis, and measurable learning outcomes. Longitudinal and multi-institutional studies would provide stronger evidence than short-term acceptance surveys.

XI. CONCLUSION AND FUTURE WORK

Learning Management Systems have evolved from basic computer-assisted and course-management tools into integrated digital ecosystems that support teaching, communication, assessment, analytics, and increasingly intelligent learning services. The literature shows that successful LMS implementation depends on a combination of technology quality, user acceptance, institutional support, instructional design, accessibility, security, and responsible data practices. The growing integration of AI and learning analytics creates important opportunities for personalization and early academic support, but these technologies should complement rather than replace the educational role of instructors. A future-ready LMS should therefore be learner-centered, interoperable, secure, accessible, and evidence-driven. The multidimensional perspective presented in this survey provides a practical foundation for institutions and researchers to evaluate LMS development beyond individual features and toward sustainable educational outcomes.

The literature reviewed in this study covers the major stages and dimensions of learning management system research, ranging from the early development of computer-supported learning to contemporary AI-enabled educational environments. As summarized in Table 2, the selected studies include conceptual frameworks, theoretical models, empirical investigations, systematic reviews, comparative analyses, and methodological works. The literature shows a clear

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TABLE 2. SUMMARY OF KEY LITERATURE REVIEWED IN THE MULTIDIMENSIONAL ANALYSIS OF LEARNING MANAGEMENT SYSTEMS.

Study	*Year*	*Research focus*	*Approach*	*Main contribution*
Watson & Watson	2007	LMS definition and conceptual boundaries	Conceptual review	Clarifies LMS functions and argues for a broader view of LMSs.
Bradley	2021	LMS use in online instruction	Review/empirical synthesis	Highlights LMS functionality and factors affecting effective online instruction.
Sanchez et al.	2024	Comparison of higher-education LMS platforms	Comparative evaluation	Shows variation across functionality, accessibility, interoperability, communication and security.
Prahani et al.	2022	LMS research trends from 1991–2021	Bibliometric analysis	Identifies major research themes and the growing role of technology in education.
Al-Fraihat et al.	2020	E-learning system success	Empirical study	Links system, information and service quality with user satisfaction and learning success.
Turnbull et al.	2022	LMS policy in higher education	Policy review	Identifies common institutional policy areas governing LMS use.
Taylor	1980	Computer in education	Foundational work	Provides the Tutor–Tool–Tutee perspective underlying computer-supported learning.
Bitzer et al.	1966	PLATO computer-controlled teaching	Historical system study	Demonstrates an early large-scale computer-supported instructional environment.
Garrison & Anderson	2003	E-learning framework	Conceptual framework	Explains teaching, social and cognitive presence in online learning.
Anderson	2008	Online learning theory and practice	Reference book	Provides a broad framework for designing and evaluating online learning.
Sultan	2010	Cloud computing for education	Conceptual review	Explains how cloud computing can improve scalability and access in education.
Mell & Grance	2011	Cloud computing definition	Technical standard	Defines the essential characteristics and service models of cloud computing.
Luckin	2018	Machine learning and education	Conceptual analysis	Discusses how intelligent technologies can support future learning.
Holmes et al.	2019	AI in education	Conceptual/research synthesis	Examines opportunities and implications of AI for teaching and learning.
Snyder	2019	Literature review methodology	Methodological review	Provides guidance for designing rigorous literature reviews.
Okoli	2015	Standalone systematic literature review	Methodological guide	Provides a structured process for conducting literature reviews.
Webster & Watson	2002	Literature review development	Methodological paper	Emphasizes concept-centric synthesis rather than simple article-by-article description.
Page et al.	2021	PRISMA 2020	Reporting guideline	Provides a transparent framework for reporting systematic reviews.
Ifenthaler & Gibson	2020	Learning analytics in higher education	Edited research volume	Examines adoption and use of analytics for learning and teaching.
Davis	1989	Technology Acceptance Model	Theoretical model	Introduces perceived usefulness and perceived ease of use as key acceptance factors.
Venkatesh et al.	2003	UTAUT	Theoretical model	Combines major acceptance constructs to explain technology use intention and behaviour.
Rogers	2003	Diffusion of Innovations	Theoretical framework	Explains how innovations spread through social systems.
DeLone & McLean	2003	Information systems success	Success model	Links system quality, information quality, service quality, use, satisfaction and benefits.
Ziraba et al.	2020	Moodle adoption and use	Systematic literature review	Identifies technological, social, human and organizational influences on LMS adoption.
Alomari et al.	2020	Human factors in LMS effectiveness	Framework/review	Emphasizes human and organizational factors in LMS effectiveness.
Fearnley & Amora	2020	LMS adoption using extended TAM	Empirical adoption study	Applies acceptance constructs to explain LMS adoption in higher education.
Kasim & Khalid	2016	LMS selection for higher education	Systematic review	Identifies criteria for selecting LMS platforms in institutional contexts.
Cavus & Zabadi	2014	Open-source LMS comparison	Comparative study	Compares open-source platforms and their suitability for educational use.
Blumenstein	2020	Learning analytics and learning design	Systematic review	Examines links between analytics, learning design and student outcomes.
Pawar & Dongardive	2025	AI in LMS	Systematic review	Reviews emerging AI applications and impacts in higher-education LMS environments.
Watson & Watson	2007	LMS definition and conceptual boundaries	Conceptual review	Clarifies LMS functions and argues for a broader view of LMSs.

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Bradley	2021	LMS use in online instruction	Review/empirical synthesis	Highlights LMS functionality and factors affecting effective online instruction.
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Pawar & Dongardive	2025	AI in LMS	Systematic review	Reviews emerging AI applications and impacts in higher-education LMS environments.

progression from understanding the basic role and architecture of LMS platforms toward examining user acceptance, institutional implementation, learning analytics, cloud computing, and artificial intelligence. Foundational studies provide the theoretical basis for understanding LMSs and technology adoption, while more recent studies focus on platform comparison, data-driven learning, and intelligent educational technologies. Taken together, these studies indicate that LMS research has become increasingly multidisciplinary, involving technological, pedagogical,

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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organizational, and user-centered perspectives. This synthesis provides the basis for the multidimensional analysis presented in the following sections.

XII. FUTURE WORK

Future research should focus on developing more intelligent, personalized, secure, and inclusive learning management systems that respond to the changing needs of higher education. The reviewed literature indicates a need for stronger evidence on the long-term educational impact of AI-enabled LMSs, learning analytics, adaptive learning, and immersive technologies rather than relying mainly on short-term measures of acceptance or engagement. Further research should examine privacy, explain ability, academic integrity, accessibility, interoperability, and responsible use of learner data. Multi-institutional and longitudinal studies across different countries and educational contexts could provide stronger evidence regarding LMS effectiveness and adoption. Future LMS development should also emphasize human-cantered design, where intelligent technologies complement instructors and support meaningful interaction between teachers and learners.

REFERENCES

[1] W. R. Watson and S. L. Watson, "An argument for clarity: What are learning management systems, what are they not, and what should they become?", TechTrends, vol. 51, no. 2, pp. 28–34, 2007.

[2] V. M. Bradley, "Learning Management System (LMS) use with online instruction," International Journal of Technology in Education, vol. 4, no. 1, pp. 68–92, 2021, doi: 10.46328/ijte.36.

[3] L. Sanchez, J. Penarreta, and X. Soria Poma, "Learning management systems for higher education: a brief comparison," Discover Education, vol. 3, art. 58, 2024, doi: 10.1007/s44217-024-00143-5.

[4] B. K. Prahani, J. Alfin, A. Z. Fuad, H. V. Saphira, E. Hariyono, and N. Suprapto, "Learning Management System (LMS) Research During 1991–2021: How Technology Affects Education," International Journal of Emerging Technologies in Learning, vol. 17, no. 17, pp. 28–49, 2022, doi: 10.3991/ijet.v17i17.30763.

[5] D. Al-Fraihat, M. Joy, R. Masa'deh, and J. Sinclair, "Evaluating e-learning systems success: An empirical study," Computers in Human Behavior, vol. 102, pp. 67–86, 2020, doi: 10.1016/j.chb.2019.08.004.

[6] D. Turnbull, R. Chugh, and J. Luck, "An overview of the common elements of learning management system policies in higher education institutions," TechTrends, vol. 66, pp. 855–867, 2022, doi: 10.1007/s11528-022-00752-7.

[7] R. Taylor, The Computer in the School: Tutor, Tool, Tutee. New York, NY, USA: Teachers College Press, 1980.

[8] D. L. Bitzer, E. R. Lyman, and J. A. Easley Jr., "The uses of PLATO: A computer controlled teaching system," Audiovisual Instruction, vol. 11, pp. 16–21, 1966.

[9] D. R. Garrison and T. Anderson, E-Learning in the 21st Century: A Framework for Research and Practice. London, UK: Routledge, 2003.

[10] T. Anderson, The Theory and Practice of Online Learning, 2nd ed. Edmonton, Canada: Athabasca University Press, 2008.

[11] N. Sultan, "Cloud computing for education: A new dawn?", International Journal of Information Management, vol. 30, no. 2, pp. 109–116, 2010, doi: 10.1016/j.ijinfomgt.2009.09.004.

[12] P. Mell and T. Grance, The NIST Definition of Cloud Computing, NIST Special Publication 800-145. Gaithersburg, MD, USA: National Institute of Standards and Technology, 2011.

[13] R. Luckin, Machine Learning and Human Intelligence: The Future of Education for the 21st Century. London, UK: UCL Institute of Education Press, 2018.

[14] W. Holmes, M. Bialik, and C. Fadel, Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Boston, MA, USA: Center for Curriculum Redesign, 2019.

[15] H. Snyder, "Literature review as a research methodology: An overview and guidelines," Journal of Business Research, vol. 104, pp. 333–339, 2019, doi: 10.1016/j.jbusres.2019.07.039.

[16] C. Okoli, "A guide to conducting a standalone systematic literature review," Communications of the Association for Information Systems, vol. 37, no. 43, pp. 879–910, 2015, doi: 10.17705/1CAIS.03743.

[17] J. Webster and R. T. Watson, "Analyzing the past to prepare for the future: Writing a literature review," MIS Quarterly, vol. 26, no. 2, pp. xiii–xxiii, 2002.

[18] M. J. Page et al., "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," BMJ, vol. 372, n71, 2021, doi: 10.1136/bmj.n71.

[19] K. Ifenthaler and D. Gibson, eds., Adoption of Data Analytics in Higher Education Learning and Teaching. Cham, Switzerland: Springer, 2020, doi: 10.1007/978-3-030-47392-1.

[20] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," MIS Quarterly, vol. 13, no. 3, pp. 319–340, 1989.

[21] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," MIS Quarterly, vol. 27, no. 3, pp. 425–478, 2003.

[22] E. M. Rogers, Diffusion of Innovations, 5th ed. New York, NY, USA: Free Press, 2003.

[23] W. H. DeLone and E. R. McLean, "The DeLone and McLean model of information systems success: A ten-year update," Journal of Management Information Systems, vol. 19, no. 4, pp. 9–30, 2003, doi: 10.1080/07421222.2003.11045748.

[24] A. Ziraba, G. C. Akwene, A. M. Nkea, and S. C. Lwanga, "The adoption and use of Moodle learning management system in higher institutions of learning: A systematic literature review," American Journal of Online and Distance Learning, vol. 2, no. 1, pp. 1–21, 2020, doi: 10.47672/ajodl.489.

[25] M. M. Alomari, H. El-Kanj, N. I. Alshdaifat, and A. Topal, "A framework for the impact of human factors on the effectiveness of learning management systems," IEEE Access, vol. 8, pp. 23542–23558, 2020.

[26] M. R. Fearnley and J. T. Amora, "Learning management system adoption in higher education using the extended technology acceptance model," IAFOR Journal of Education, vol. 8, no. 2, pp. 89–106, 2020.

[27] N. N. M. Kasim and F. Khalid, "Choosing the right learning management system (LMS) for the higher education institution context: A systematic review," International Journal of Emerging Technologies in Learning, vol. 11, no. 6, 2016.

[28] N. Cavus and T. Zabadi, "A comparison of open source learning management systems," Procedia - Social and Behavioral Sciences, vol. 143, pp. 521–526, 2014.

[29] M. Blumenstein, "Synergies of learning analytics and learning design: A systematic review of student outcomes," Journal of Learning Analytics, vol. 7, no. 3, pp. 13–32, 2020.

[30] M. Pawar and J. Dongardive, "Leveraging artificial intelligence in learning management systems: A systematic review of applications and impacts in higher education," Indian Journal of Science and Technology, vol. 18, no. 38, pp. 3124–3135, 2025, doi: 10.17485/IJST/v18i38.1648