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A Systematic Literature Review on Hybrid Learning Management Systems: Research Gaps and Model Design

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ABSTRACT

This study aims to systematically examine literature related to the development of hybrid Learning Management Systems (LMS), focusing on system integration models, cross-platform usability aspects, and their effectiveness in supporting student engagement and learning outcomes. The review was conducted using a Systematic Literature Review (SLR) approach following the PRISMA 2020 guidelines. Out of a total of 1,342 identified publications, 25 studies met the inclusion criteria and were analyzed further.The synthesis results indicate that hybrid LMS integration is still largely dominated by technical approaches, such as the use of APIs, interoperability standards, and hybrid recommendation systems. However, most studies have not yet fully incorporated pedagogical principles into the system design. Usability analysis reveals that web platforms tend to be more capable of supporting complex learning activities, while mobile platforms offer flexibility but are limited by deeper navigation structures and interface consistency challenges.In terms of effectiveness, several studies reported increased engagement and support for adaptive learning, although empirical evidence regarding impacts on learning outcomes remains limited. Overall, the success of hybrid LMS depends on alignment between technical integration, UX design, and pedagogical needs. Future research is recommended to develop and evaluate hybrid LMS prototypes that meaningfully integrate structured and self-directed learning, conduct in-depth cross-platform usability evaluations, and explore hybrid LMS models that incorporate artificial intelligence (AI) as an adaptive component within the learning process.

INTRODUCTION

The rapid advancement of digital technologies in education has accelerated the adoption of Learning Management Systems (LMS) as a core component supporting online and blended learning across various educational institutions (Pan et al., 2024). Most existing LMS platforms remain aligned with a structured instructional model in which learning flow, content delivery, and assessment are primarily controlled by instructors or system administrators. While this model ensures curricular alignment and standardization, it is often criticized for its limited flexibility in accommodating diverse learner needs, preferences, and learning paces (Lampropoulos, 2023).

Conversely, a growing number of learning environments are shifting toward self-directed learning models, which place learners at the center of the learning process. This approach allows students to explore learning pathways based on their interests and perceived relevance. Although this model provides greater autonomy and personalization, it often lacks coherent curricular guidance and systematic instructional support. As a result, its effectiveness may be reduced, particularly when learners require structured scaffolding to maintain learning progression and clarity of learning objectives(Petrovic & Alvarez, 2025).

These contrasting conditions highlight the need for an integrative approach capable of combining the strengths of both structured and self-directed learning models into a unified system. This concept is referred to as a Hybrid Learning Management System (Hybrid LMS). Such a system is expected to support adaptive learning maintaining alignment with institutional curriculum requirements while simultaneously enabling personalization based on learner profiles, preferences, and competency progression.

Despite increasing interest in hybrid LMS development, several research gaps remain. First, there is no comprehensive conceptual model explaining the integration mechanism between structured LMS environments and self-directed learning systems. Second, cross-platform usability particularly the comparison of web-based and mobile-based user experiences has not been sufficiently explored in the context of hybrid systems, even though usability strongly influences system adoption and user satisfaction. Third, there is limited understanding of how hybrid LMS implementations can maintain an optimal balance between instructor control and learner autonomy without creating role conflict in digital learning governance.

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Therefore, this study aims to systematically map existing literature addressing the integration of structured LMS and self-directed learning environments, with the objective of identifying research gaps and proposing an initial conceptual framework for Hybrid Learning Management Systems. To achieve this objective, three research questions (RQs) are formulated:

- **RQ1:** What integration models have been proposed in the literature for combining structured and self-directed LMS environments?
- **RQ2:** What are the research findings regarding cross-platform usability particularly the comparison between web and mobile user experience in hybrid LMS implementations?
- **RQ3:** To what extent has the hybrid LMS model demonstrated effectiveness in improving student engagement and learning outcomes?

By addressing these research questions, this study is expected to contribute theoretically to the development of hybrid LMS frameworks and provide a foundation for future research focusing on intelligent technologies that support more adaptive, personalized, and flexible digital learning ecosystems.

LITERATURE REVIEW

Research on Learning Management Systems (LMS) has grown significantly in recent years, particularly alongside the increasing demand for more flexible and adaptive learning models. Early generations of LMS were generally designed using a structured approach in which learning flow, content delivery, and assessment were fully controlled by instructors or institutions. While this approach is considered effective for ensuring curriculum standardization, several researchers argue that such models offer limited space for personalization and learner autonomy (Lampropoulos, 2023). Conversely, the emergence of self-directed digital learning platforms has enabled learners to select learning paths based on their interests and individual needs. Although this approach offers greater flexibility, studies indicate that fully independent learning environments often lack sufficient instructional guidance, which may reduce learning effectiveness (Petrovic & Alvarez, 2025).

Hybrid Learning Management System

To bridge these two approaches, recent studies have discussed the concept of Hybrid Learning Management Systems (Hybrid LMS). A hybrid system aims to combine formal, structured instructional approaches with adaptive features that enable personalized learning. System integration is commonly achieved through mechanisms such as hybrid recommender systems, interoperability standards (e.g., LTI), and the use of APIs, allowing platforms to share data and synchronize learning activities (da Silva et al., 2023; Petrovic & Alvarez, 2025). Several studies also emphasize that integration does not merely refer to merging two systems, but to aligning learning pathways so that the transition between platforms occurs smoothly (Pan et al., 2024).

However, a considerable portion of the literature highlights a gap between technical and pedagogical integration. Previous studies indicate that the development of hybrid LMS models remains dominated by computational and systems engineering perspectives, while pedagogical theory and instructional design principles are less emphasized (Aucancela et al., 2023; Siafis et al., 2024). As a result, many hybrid LMS models are technologically sophisticated but do not fully address the pedagogical needs of instructors and learners.

Usability and Cross-Platform User Experience

Usability and user experience (UX) also represent key focus areas in hybrid LMS research. Prior studies show that differences exist in user interaction patterns between web-based LMS platforms and mobile applications. Web-based LMS generally offer advantages for complex academic activities such as reading extensive materials, managing assignments, or monitoring learning progress (Abid et al., 2024; Williams, 2022). In contrast, mobile-based LMS platforms are more commonly used for lightweight activities such as checking notifications, viewing announcements, or submitting quick responses (Gumasing et al., 2022; Kurniawan et al., 2023).

Research findings also indicate that cross-platform interface consistency is a critical factor influencing user experience. Challenges such as differing navigation structures between web and mobile versions, low responsiveness, and inconsistent visual layouts can negatively affect the effectiveness of hybrid LMS usage (Alkoblan & Wadud, 2023). These findings suggest that the success of hybrid LMS implementation depends not only on system functionality but also on interface design quality and workflow smoothness.

Effectiveness of Hybrid LMS on Learning Outcomes

A number of studies investigate the effectiveness of hybrid LMS in improving student engagement and learning performance. Some research reports that features such as learning analytics, adaptive feedback, and automated recommendations can enhance learner motivation and participation (Bergdahl et al., 2024; Chen, 2025). However, empirical evidence demonstrating the direct impact of hybrid LMS on learning outcomes remains limited. Existing findings are highly dependent on implementation context, technological readiness, user digital literacy, and institutional

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support.

Researchers also emphasize that the effectiveness of hybrid LMS can only be achieved when technical architecture, user experience, and instructional strategy are aligned (Ngulube & Ncube, 2025). Systems developed solely from a technological perspective without considering educational needs often produce suboptimal learning experiences.

Overall, the literature shows growing interest in hybrid LMS, particularly in relation to system interoperability, adaptive learning, and cross-platform usability. However, the findings also indicate that current research remains fragmented and does not provide a clear integration model between structured LMS environments and self-directed learning platforms. Specifically, no study was found that discusses or implements integration between structured LMS platforms that regulate learning flow, assessment, and curriculum alignment and self-directed learning environments where learners freely select content and learning pace. This gap reinforces the importance of the present study in mapping existing findings and proposing an initial conceptual framework for Hybrid LMS development in the future.

METHOD

This study employed a Systematic Literature Review (SLR) approach to identify, analyze, and synthesize current research related to the development and implementation of Hybrid Learning Management Systems (Hybrid LMS). The SLR method was selected because it provides a rigorous and structured mechanism for mapping existing research and identifying trends, patterns, and gaps in the field. The review procedure followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. Based on these guidelines, the SLR process in this study consisted of five main stages (Page et al., 2021):

Formulating Research Questions and Developing the Review Protocol

The SLR process began with the formulation of explicit research questions aligned with the study's objectives. The research questions guiding this review were previously outlined in the introduction and served as the foundation for the development of a systematic review protocol. The protocol was designed to ensure a consistent and transparent review process and to avoid unnecessary duplication or bias throughout the review stages. It included clearly defined review objectives, inclusion and exclusion criteria, search strategies, and a predefined plan for data extraction and analysis.

Literature Identification

After finalizing the protocol, relevant literature was identified through systematic searches across major academic databases, including Scopus, IEEE Xplore, ResearchRabbit, ScienceDirect, and Google Scholar, along with additional institutional repositories. The research questions served as the primary reference point for determining the relevance of database results.

Study Selection

The next stage involved applying the inclusion and exclusion criteria to ensure that only studies relevant to the research scope were retained for analysis. Study selection occurred in two phases: (1) title and abstract screening, followed by (2) full-text screening of eligible publications. The selection process was conducted independently by two reviewers to minimize potential selection bias. Discrepancies were resolved through discussion until consensus was reached. Reference management software (Mendeley) was used to organize retrieved articles and remove duplicates. The full selection process identification, screening, eligibility, and inclusion was documented using a PRISMA flow diagram.



Fig. 1 PRISMA Flow Diagram

Data Extraction and Quality Assessment

In this stage, data from the included studies were extracted using a structured extraction form tailored to the goals of this review. Extracted information included study metadata (authors, publication year, and country), research

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design, system characteristics, evaluation methods, and key findings relevant to hybrid LMS development and implementation. A methodological quality assessment was also conducted to evaluate the rigor and potential bias of the included studies. As with the screening stage, data extraction and quality assessment were performed independently by two reviewers to ensure objectivity and reliability.

Data Synthesis and Reporting

The final stage involved synthesizing extracted data and presenting the findings. A qualitative descriptive synthesis was performed to identify patterns, similarities, differences, and emerging themes across the selected studies. The results were then structured into a narrative aligned with the formulated research questions. Additionally, potential sources of bias in the review process were acknowledged to maintain balanced interpretation of findings. The reporting of this review adhered to the PRISMA 2020 guidelines to ensure transparency, clarity, and reproducibility.

RESULT

In this section, the researcher will explain the results of the research obtained. Researchers can also use images, tables, and curves to explain the results of the study. These results should present the raw data or the results after applying the techniques outlined in the methods section. The results are simply results; they do not conclude.

Study Identification and Selection

The literature identification process was conducted through searches across multiple academic databases, resulting in 1,342 initial records. Of these, 332 were removed due to duplication. After the deduplication stage, 1,010 articles remained and were screened based on title and abstract to evaluate their relevance to the research focus.

The initial screening eliminated a substantial number of unrelated publications, leaving only 150 articles considered potentially relevant for full-text review. During the full-text screening stage, each article was evaluated against the predefined inclusion criteria. A total of 125 articles were excluded due to reasons such as lack of empirical evidence, incomplete data, or misalignment with the research scope.

As a result, only 25 studies met all criteria and were included in the final synthesis. This outcome reflects a rigorous selection process and indicates that most of the initial publications did not directly align with the research objectives. The included studies represent the most relevant and credible literature to address the predefined research questions.

Study Characteristics

The final 25 selected studies exhibit diverse characteristics in terms of publication year, research focus, methodological approach, and implementation context. The studies span from 2020 to 2025, with a notable increase in publications during 2023–2025. This trend suggests growing academic interest in hybrid LMS, educational recommender systems, learning analytics, and cross-platform usability within the field of educational technology.

Regarding research focus, approximately one-third of the studies explore recommender system integration in LMS contexts, while others examine learning analytics as a supporting component of hybrid LMS development. Several studies contribute through usability evaluation of web-based or mobile LMS platforms, directly influencing user experience considerations. Other research combines pedagogical and technical perspectives, especially those investigating the impact of hybrid systems on student engagement and learning outcomes.

The included studies employed various research methodologies, including systematic literature reviews, bibliometric analyses, experimental studies, comparative analyses, prototype validation, and conceptual modelling. This methodological diversity provides a strong foundation for comprehensive thematic synthesis. A summary of the included studies is presented in Table 1, detailing reference, publication year, research focus, methodology, key findings, and DOI/sources.

Table 1. Synthesis Mapping of 25 Studies

No	Reference & Year	Focus	Method	Key Findings
1	(da Silva et al., 2023)	1,3	Systematic literature review (recommender systems)	Hybrid recommender approaches (content-based + CF) dominate; literature heavily emphasizes technical aspects with limited pedagogical evaluation.
2	(Lampropoulos, 2023)	1,2	Bibliometric review	Increasing trend of recommender research in education; identifies need for more empirical studies (student confusion between structured and autonomous learning).
3	(Khanal & Pokhrel, 2024)	2,3	Model proposal + framework (PLI–DLE)	Proposed PLI framework using Federated Learning for adaptive personalization while maintaining data privacy.
4	(Ngulube & Ncube, 2025)	3	Review/empirical (MDPI Information)	Clear instructional design and good usability significantly improve user experience and learning

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				quality.
5	(Siafis et al., 2024)	2,3	Systematic review (teacher-facing recommenders)	Highlights the need for recommender tools that support instructional decision-making and pedagogical constraints.
6	(Maruyama et al., 2023)	2	Pengembangan prototipe (hybrid recommender)	Developed SmartC hybrid filtering architecture; system demonstrates strong accuracy in educational recommendations.
7	(Pan et al., 2024)	1,3	Systematic Literature Review (27 studies, 2012–2023)	Learning analytics interventions dominated by dashboards and prompting; multifunctional approaches yield better outcomes and emphasize SRL and usability.
8	(Abdulquadir et al., 2023)	2	Empirical usability study (SIGITE)	UX problems in Canvas LMS negatively affect task success; interface improvement recommended.
9	(Alkoblan & Wadud, 2023)	2	Model proposal + validation	Proposed a usability evaluation framework suitable for cross-platform LMS testing.
10	(Williams, 2022)	2	Case study / thesis (Canvas UX)	Web platform outperforms mobile in navigation and interface completeness; mobile less efficient for complex use.
11	(Abid et al., 2024)	3	Comparative analysis (open access)	Provides an evaluation framework for essential LMS features critical for hybrid integration and UX.
12	(Kaliisa et al., 2024)	2,3	Review (Learning Analytics Dashboards)	LADs often fail to meet instructional needs despite technical availability; highlights practice-potential gap.
13	(Bergdahl et al., 2024)	1,3	Systematic review (engagement & LA)	Personalization improves engagement; learners feel confused without guidance yet still require additional recommendations.
14	(Paolucci et al., 2024)	3	Systematic review (LA in LMS)	Challenges in implementing learning analytics in LMS include interoperability, data standards, and interpretability.
15	(Chen, 2025)	1,3	SLR (LA in inquiry-based learning)	Learning analytics support pedagogical adaptation; limited evidence on impact toward learning outcomes.
16	(Molinari & Sandri, 2024)	1,2	Conceptual study / new LMS architecture	Proposed LMS architecture using knowledge-graph design, improving semantic search, recommendation, and personalization.
17	(Petrovic & Alvarez, 2025)	1,3	Prototype + experimental (hybrid recommender)	Hybrid filtering increases engagement; prototype has not yet examined instructor pedagogical involvement.
18	(Aucancela et al., 2023)	1	SLR (Cochrane-based)	Educational recommender systems commonly use hybrid filtering; strong personalization impact but limited pedagogical alignment.
19	(Bhutoria, 2022)	2,3	Systematic review (2019–2021 using IEEE Xplore)	AI supports personalization via predictive analytics and recommendations; improves learning experience but faces privacy and access challenges. Confirms need for AI integration in hybrid LMS.
20	(Pal & Dahiya, 2023)	1,2	Preprint review	Explores essential requirements and features needed for hybrid learning LMS.
21	(Gumasing et al., 2022)	2	Empirical comparative study	Mobile LMS performance is limited due to small display, low responsiveness, and shallow navigation, negatively affecting satisfaction and effectiveness.
22	(Kurniawan et al., 2023)	2	Usability / SUS study (mobile LMS)	Low SUS scores reported for mobile LMS case study; requires interface redesign.
23	(Ikhsan et al., 2025)	2	Qualitative literature review	Recommended AI implementation strategies in LMS: adaptivity, predictive analytics, and instructor training.
24	(Butmeh & Abu-Issa, 2024)	1,2	System development & evaluation (hybrid attribute-based recommender)	Hybrid recommender overcomes cold-start issues using user and content attributes; improves accuracy and personalization.
25	(Heathen, 2025)	1,3	Narrative review	LMS enhances flexibility and engagement but remains limited by digital literacy and infrastructure gaps; AI integration needed for personalization.

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Analysis Based on Research Questions

RQ1: LMS Integration Models

The literature analysis shows that most research emphasizes technical integration approaches designed to enhance and expand learning system functionality. Studies such as da Silva et al. (2023), Lampropoulos (2023), and Petrovic & Alvarez (2025) demonstrate that system integration is commonly achieved through hybrid recommender systems combining content-based and collaborative filtering, along with the use of APIs and interoperability standards such as LTI.

Findings suggest that LMS integration extends beyond platform merging and includes data synchronization, alignment of learning activities, and centralized access. Several studies highlight that such integration supports personalized content delivery and prevents learner confusion when transitioning between structured and self-directed learning tools.

However, several studies also identify a disconnect between technical integration and pedagogical implementation. Researchers such as Siafis (2024), Pal & Dahiya (2023), and Aucancela et al. (2023) emphasize that although technical integration is advancing, many systems still lack alignment with instructional design and teaching roles.

RQ2: Web vs Mobile Usability in Hybrid LMS Implementation

Usability emerged as the most frequently studied topic, particularly in the context of comparing web-based and mobile LMS platforms. Studies such as Williams (2022) and Abid et al. (2024) find that web-based platforms provide better stability, feature completeness, and navigational efficiency for complex learning activities such as content exploration, assignment management, and grade review.

In contrast, mobile platforms provide more flexible and immediate access, commonly used for micro-interactions such as announcements, forum replies, or quick confirmations. However, studies including Kurniawan et al. (2023) and Gumasing et al. (2022) report usability barriers on mobile platforms, including limited display, reduced responsiveness, and shallow navigation structures, which restrict their use for deeper learning tasks.

Consistently, usability studies indicate that user experience in hybrid LMS environments is strongly influenced by interface quality and interaction flow. Common issues include task failure, visibility problems, inconsistency across devices, and slow response time.

RQ3: Effectiveness of Hybrid LMS

Analysis of the included studies shows that hybrid LMS implementations demonstrate potential in increasing student engagement. Studies such as Bergdahl et al. (2024), Chen (2025), and Abid et al. (2024) provide evidence that integrating features such as learning analytics, automated feedback, and adaptive recommendations can improve learner motivation and participation.

However, only a small number of studies provide empirical evidence directly linking hybrid LMS usage to measurable improvements in learning outcomes. Furthermore, reported effectiveness is influenced by technological readiness, digital literacy, and institutional support.

DISCUSSION

The synthesis of findings across the three research questions demonstrates a clear interdependence between system integration, cross-platform usability, and learning effectiveness in the context of Hybrid LMS development. The analysis from RQ1 indicates that existing studies predominantly approach integration from a technical standpoint, emphasizing mechanisms such as interoperability standards, API-based communication, and hybrid recommender systems. However, pedagogical alignment remains limited, suggesting that current integration models are still system-driven rather than learning-driven. This gap reinforces the need to shift from merely connecting platforms toward designing pedagogically meaningful hybrid learning ecosystems.

Insights from RQ2 further highlight the importance of user experience design in hybrid learning environments. Persistent usability issues particularly inconsistencies between web and mobile interfaces demonstrate that technical integration alone is insufficient if it does not support seamless learner interaction. These findings imply that hybrid LMS systems must ensure continuity of experience across devices, especially given the growing reliance on mobile learning for micro-interaction and just-in-time access.

Finally, the evidence from RQ3 suggests that the effectiveness of hybrid LMS is contingent upon the balance between technical capability, interface usability, and pedagogical design. While hybrid LMS features such as learning analytics, adaptive feedback, and recommendation models show potential to enhance engagement, their impact on measurable learning outcomes remains limited without supportive instructional design, user readiness, and institutional infrastructure.

Taken together, the findings indicate that the successful development of hybrid LMS requires a more holistic and multidimensional approach one that integrates technical architecture, user-centered design, and pedagogical intent. Future research and system development should therefore prioritize models that not only connect structured and self-

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directed learning platforms, but also ensure that such integration promotes coherent learning pathways, equitable access, and meaningful learner support.

CONCLUSION

This study systematically reviewed the existing literature related to the development of Hybrid Learning Management Systems (LMS), focusing on system integration models, cross-platform usability, and their effectiveness in supporting learner engagement and learning outcomes. Following the PRISMA 2020 guidelines, a total of 25 studies met the inclusion criteria and were analyzed. The synthesis of findings indicates that although the concept of hybrid LMS continues to develop, there is currently no comprehensive model that fully integrates structured learning environments with self-directed learning systems. Most prior research discusses both approaches separately or links them only through isolated platform features, without proposing a unified conceptual framework.

The findings imply that the successful development of hybrid LMS requires more than technical integration; it must also consider user experience design and pedagogical alignment to support adaptive and meaningful learning. Therefore, this review provides a theoretical foundation for educational institutions, system developers, and researchers to conceptualize and design hybrid LMS models that are more holistic, relevant, and supportive of personalized learning pathways.

Despite its contributions, this study has limitations. The literature scope was restricted to studies published between 2020-2025 and limited to selected academic databases, which may exclude earlier or less accessible yet relevant works. Additionally, the findings are conceptual in nature, as no empirical validation of proposed integration models was conducted, making the results dependent on the methodological rigor of the reviewed studies.

Future research is recommended to develop and empirically evaluate a working prototype or framework that integrates structured and self-directed learning environments within a single hybrid LMS. Further studies should also explore the role of adaptive technologies such as artificial intelligence and learning analytics to enhance personalization, support academic risk prediction, and enable adaptive feedback within hybrid LMS ecosystems.

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