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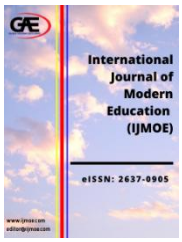

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FROM PLATFORMS TO PRACTICE: A SYSTEMATIC REVIEW OF LEARNING MANAGEMENT SYSTEM INTEGRATION IN VOCATIONAL TEACHING

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Abstract:

This systematic literature review examines the integration of Learning Management Systems (LMS) in vocational education and training, a sector undergoing rapid digital transformation. Although LMS adoption is widespread, vocational contexts face challenges of pedagogical alignment, digital competence, and contextual adaptability. Following PRISMA guidelines, articles indexed in Scopus and Web of Science were systematically searched using keywords such as "Learning Management System", "Digital Learning", and "Vocational Education". From 8,828 initial results, 51 high-quality studies were included for analysis. Thematic synthesis identified three core themes. First, LMS adoption, implementation, and user interaction highlighted institutional readiness, user perceptions, and infrastructural limitations. Second, LMS integration with interactive elements, hybrid learning, and instructional design emphasized pedagogical innovations, content personalization, and digital tools. Third, the role of learning analytics, AI, and adaptive pathways underscored data-informed practices and personalized learning. Findings suggest LMS can enhance vocational training through engagement and instructional delivery but challenges persist in usability, hands-on skill development, and teacher training. Effective deployment requires alignment of platform features with vocational pedagogy, supported by infrastructure and professional development. This review contributes a thematic framework, practical recommendations, and future research directions, emphasizing context-sensitive strategies and the potential of AI and analytics to optimize LMS in vocational education.

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Keywords:

Learning Management Systems (LMS), Technical and Vocational Education and Training (TVET), Artificial Intelligence (AI)–Driven Adaptive Learning, Learning Analytics, Gamification, Mobile Learning, Microlearning

Introduction

Learning Management Systems (LMS) used to be something educational institutions could choose to use or not, but presently they are an important part of how we teach and learn (Alturki & Aldraiweesh, 2021; Bervell & Arkorful, 2020; Bradley, 2020). LMS might actually benefit institutions that teach vocational education and training (TVET). The main goal of TVET is to give students the skills they need, to get jobs (Mesuwini et al., 2023; Omar et al., 2020; Sani et al., 2023). LMS platforms, on the other hand, help users keep track of their skills, work together, test their skills, and circulate materials. People want to learn on the job at their own pace (Hondonga et al., 2022; Jamalludin et al., 2022; Thapa, 2024) and keep up with how quickly technology is changing. This is making LMS more and more important at working environments. As a greater number of organisations move online, vocational institutions are getting more attention for teaching skills that are useful in the digital world. The utilisation of a LMS for instruction is a creative technique and an essential component in job candidates preparation. The majority of the existing studies on education technology systems were focused on higher learning institutions. Researchers assessed platforms that ranged from Google Classroom, Moodle, and Blackboard to assess the effectiveness in content distribution, learner engagement, and assessment methods. The literature recommends that the use of LMS has the potential of improving student engagement, broadening the reach of educational resources, and automating the education of instructional roles (Al-Nuaimi & Al-Emran, 2021; Liu & Geertshuis, 2021; Matarirano et al., 2020). According to recent studies in the field of vocational education, LMS has proved to be effective, especially when applied in the blended and hybrid forms of learning where both the theoretical and practical parts are used. Research in the sphere of Indonesian vocational education shows that LMS increases student independence and academic results (Ismail et al, 2023; Jannah et al., 2023). Although there are empirical advances in the literature regarding LMS integration in vocational education, particularly in different national settings and industrial sectors, it is still unified. The current literature often generalises the results of the research conducted in traditional classrooms and fails to consider the individual contextual factors that are particular to vocational education or involve practical skills, apprenticeship models, and industry requirements.

The application of LMS into practical education has been an issue of concern despite the increased focus. To begin with, LMSs are not yet set up to support skills-based, experiential, and integrated learning at work. Current systems are generally developed for academic material, restricting their capacity to track real-world abilities or simulate industrial settings. Second, significant disparities in digital infrastructure, institutional capacity, and instructors' digital literacy hinder LMS adoption across vocational institutions, especially in developing countries. Additionally, there remains limited research on how LMS use intersects with teacher professional identity, instructional design practices, and student socio-emotional engagement in hands-on learning environments. These gaps underscore a need for more context-sensitive, empirical investigations that explore not only the technological capabilities of LMS but also

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their alignment with vocational pedagogical frameworks. Going forward, we recommend a dual focus: (i) empirical research that captures best practices and innovation models for LMS integration in vocational settings, and (ii) policy-driven support systems that address training, infrastructure, and content customization for vocational instructors. Future research should also explore how LMS can be optimized using analytics, adaptive learning, and industry partnerships to better align with the evolving needs of vocational learners and labor markets.

Literature Review

Recent research portrays Learning Management Systems (LMS) as central infrastructure in vocational education and training (VET/TVET), but effectiveness depends on alignment with competency-based pedagogy, infrastructure reliability, and sustained teacher capacity (Hussein, 2023). Post-2019 studies show that LMS use has broadened beyond content hosting toward orchestrating blended and hybrid learning (Bashir et al., 2021; Dube et al., 2023), assessment, and data-informed support; nevertheless, uneven adoption, limited instructional design expertise, and contextual constraints still attenuate outcomes, particularly in developing regions. Reviews of Moodle use and broader platform trends underscore the surge of LMS-mediated delivery since 2020 while cautioning that tool proliferation often outpaces pedagogical models and teacher development (Lestari et al., 2021), especially where practical, workplace-oriented competencies must be demonstrated rather than merely assessed online (Gamage et al., 2022; Hennessy et al., 2022).

At the level of organizational readiness and user acceptance, studies grounded in TAM/UTAUT and IS-success models indicate that perceived usefulness, ease of use, service/system quality, and support predict LMS intention and sustained use, but vocational contexts introduce additional determinants such as practical training affordances and psychomotor skill requirements (Almashhadani et al., 2023; Humida et al., 2022). A TVET-focused instrument validation in Malaysia identified acceptance factors specific to hands-on training alongside classic IS-quality constructs, reinforcing that generic higher-education LMS models under-specify TVET needs (Ahmad et al., 2023). Mobile-first ecosystems have become especially salient: Malaysian work on Google Classroom highlights usability and mobile access as adoption drivers, yet also flags limits around analytics and assessment depth relative to institutional LMSs (Kumar, 2020). In lower-resource African contexts, acceptance and continuance intentions are strongly shaped by infrastructural reliability and facilitating conditions, with Nigerian evidence showing that self-efficacy and performance expectancy are necessary but insufficient without dependable connectivity and institutional support (Yakubu et al., 2020). Ghanaian adoption work echoes these findings, adding that perceived relevance to program goals mediates sustained uptake (Segbenya et al., 2023). Collectively, the literature suggests that policy and platform decisions must incorporate local constraints (bandwidth, devices, support) as first-order design variables rather than afterthoughts.

Pedagogically, blended and hybrid configurations dominate vocational settings because they can couple online theory with in-person skills practice (Lim et al., 2022; Qiu, 2022). However, design quality and learner readiness moderate results. A large-scale review of blended learning identifies persistent challenges around passive learning and staff training, risks that are amplified in competence-based programs if online activities are weakly integrated with workshop/lab tasks. Moreover, TVET-specific readiness studies from South Asia reveal that attitudes toward online learning and openness to technology are positive, but basic technology skills and self-management can lag, jeopardizing the pacing and feedback loops needed for

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skill acquisition (Shakeel et al., 2023). These findings argue for explicit instructional design support (sequencing, scaffolding, authentic tasks) and targeted preparatory modules that cultivate the study and digital skills necessary for effective blended TVET.

Emerging technologies now shape LMS-enabled vocational teaching in three prominent ways: gamification, immersive labs (VR/AR), and AI-driven adaptivity. A recent Education & Information Technologies review centered on VET documents how game mechanics, challenge-based learning, and micro-credentialing via LMS plugins can lift engagement and persistence, yet gains depend on aligning game elements with competency standards and assessment rubrics rather than bolting them on as motivational garnish (Dahalan et al., 2024). Immersive virtual and augmented reality are increasingly embedded through LMS integrations to simulate hazardous or equipment-intensive tasks; rigorous experiments show reliable boosts to motivation and presence, with knowledge gains contingent on scaffolding quality and alignment to task complexity (Thomann et al., 2024). In parallel, AI-enabled adaptive learning is maturing from proof-of-concept to deployable modules that integrate with LMS content and analytics. Systematic mappings in the Computers & Education: Artificial Intelligence venue show that adaptive engines can personalize sequencing and feedback, but robust effects in vocational contexts require high-fidelity skill models and valid performance signals from practical tasks, still a research gap where hands-on competencies are assessed off-platform or asynchronously (Kabudi et al., 2021).

Learning analytics (LA) within LMSs offers promise for early risk detection and pathway optimization, yet the evidence base urges caution. Technical examinations of Moodle logs demonstrate how client-side interactions and timestamp semantics can bias “time-on-task” and sequence metrics if preprocessing pipelines are naïve, implying that many LA dashboards may misestimate engagement or misattribute learning events, an especially acute risk in vocational modules with blended offline practice (Rotelli & Monreale, 2023). Meta-reviews similarly find modest or inconsistent effects of LA dashboards on achievement, though participation often improves; stronger causal designs and domain-specific indicators are needed to translate clickstreams into competency-valid insights for TVET. The practical implication is that institutions should pair analytics adoption with data governance, transparent modeling, and educator training on interpretation limits.

Teacher professional development (TPD) emerges as the fulcrum for all of the above. A 170-study systematic review on technology-mediated TPD in LMICs concludes that locally contextualized models, virtual coaching, blended micro-credentials, and communities of practice, improve teacher outcomes, but sustained changes in classroom (and workshop) practice require ongoing support, design guidance, and attention to equity and cost (Hennessy et al., 2022). For vocational programs, this implies moving beyond one-off LMS workshops to competency-aligned design studios where instructors co-develop hybrid modules, calibrate assessments for psychomotor outcomes, and learn to interpret LA and AI-driven recommendations responsibly.

In synthesis, the post-2019 literature supports a nuanced position: LMSs can enhance access, orchestration, and engagement in vocational education when they are mobilized as part of a design-rich, teacher-supported, and context-sensitive ecosystem. Priorities going forward include (i) integrating platform features explicitly with competency standards, simulations, and workplace assessment; (ii) resourcing infrastructure and mobile-first access in LMICs; (iii)

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investing in TPD that couples instructional design with trustworthy analytics and AI literacy; and (iv) evaluating outcomes with measures that capture skill transfer and employability rather than clicks or satisfaction alone.

Table 1: Summary Table from Existing Study

Aspect	Details
Benefits	Improved content deliverability, accessibility, and retrievability (Dahal et al., 2023) Blended learning environments (Ibrahim & Shaalan, 2023) Collaboration with industrial partners (Ng et al., 2021)
Challenges	Teacher-centric limitations (Dahal et al., 2023) Underutilization of LMS features (Ibrahim & Shaalan, 2023) Issues with content creation, communicative features, course structures, learning engagement, and assessment (Dahal et al., 2023)
Case Studies	Quality assurance in VHS LMS (Lee, Hartono, Andry, & Chakir, 2024) Development of innovative and entrepreneurial skills (Sun & Zhang, 2022; Wu, 2022) Management of virtual laboratories and remote access technology (Magetos, Sarlis, Kotsifakos, & Douligeris, 2021)

The integration of LMS in vocational education presents both opportunities and challenges. While LMS platforms can significantly enhance the quality and accessibility of vocational training, their effectiveness depends on the alignment of technological tools with pedagogical models and the specific needs of vocational programs. By addressing the challenges and leveraging the benefits, vocational education institutions can harness the full potential of LMS to improve teaching and learning outcomes.

Material and Methods

Identification

The first step in the systematic literature review (SLR) process, according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) structure, is to employ well-defined search strategies to methodically and extensively find records that could potentially be relevant. Scopus and the Web of Science (WoS) were the two primary reliable bibliographic databases used for this study. We opted for these databases because they have a lot of peer-reviewed literature, good indexing standards, and an extended record of being trusted sources of scholarly communication. To find articles that were relevant to the use of LMS in vocational learning environments, we used a keyword strategy that included words associated with "learning management system" and "vocational education." This led to the retrieval of 5,114 reports from Scopus and 3,714 from WoS, for a total of 8,828 original records. This broad range of results points to a strong and quickly changing body of research at the confluence of digital platforms and vocational pedagogy, especially when it comes to technology-enhanced learning.

The large number of records discovered can be associated with the growing focus on digital transformation in Technical and Vocational Education and Training (TVET) around the world. This is especially true because the COVID-19 pandemic sped up the use of LMSs in many different types of schools. The difference in the number of retrievals between Scopus and WoS

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is clear and makes sense. Scopus usually indexes more conference proceedings, regional journals, and open-access sources than WoS, which is more picky and only covers high-impact journals. However, using both databases together gives a wider and more complete view, reducing publication bias and making sure that a variety of research views and regional settings are included. Also, this first step of identifying research is very important for the next steps of screening, eligibility, and inclusion since it gives us a large pool of studies to choose from that have been quality-filtered and are thematically related. This breadth of initial data strengthens the reliability and validity of the SLR findings, enabling the extraction of patterns, trends, and research gaps that are globally representative and conceptually sound.

Table 2: The Search String

Scopus	(TITLE-ABS-KEY ("learning management system*" OR LMS OR "virtual learning environment*" OR VLE OR "online learning platform*") AND TITLE-ABS-KEY (vocational OR technical* OR TVET OR polytechnic OR skill*)) AND (LIMIT-TO (PUBYEAR , 2025)) AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "MATH")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (EXCLUDE (DOCTYPE , "re")) Date of Access: July 2025
WoS	"learning management system*" OR LMS OR "virtual learning environment*" OR VLE OR "online learning platform*" (Topic) AND vocational OR technical* OR TVET OR polytechnic OR skill* (Topic) and 2025 (Publication Years) and Article (Document Types) and English (Languages) and Education Educational Research or Computer Science or Engineering (Research Areas) Date of Access: July 2025

Screening

The screening stage of the PRISMA-guided SLR process is crucial in the refinement of the initial collection of records to ensure alignment with the study's objectives and methodological rigorousness, following the identification phase. A total of 8,672 records were excluded because they failed to meet rigid eligibility criteria. These records were from Scopus (5,114) and Web of Science (3,714). Some of the criteria were that publications not in English, content published before 2025, and non-peer-reviewed sources such conference proceedings, books, review articles, and papers that were still in press would not be accepted. Also, studies that weren't directly related to the core disciplines, such those that weren't in the fields of education, social science, or related interdisciplinary fields such as math, computer science, or engineering, were excluded. This improved screening procedure is necessary to keep the focus on outstanding evidence-based research that add to the conversation about how to integrate LMS into vocational education settings.

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After the elimination process, 156 records were kept for first inclusion, 97 were retrieved from Scopus and 59 came from WoS. We also located and eliminated 27 duplicate records from the two databases to avoid data redundancy and analytical distortion, which is a common problem in bibliometric and systematic analyses. The big fall from 8,828 to 156 records shows how important it is to have a screening technique that is methodologically sound and focusses on relevance, recency, language, and publishing quality. This procedure makes sure that only articles that have been peer-reviewed, fit with the context, and are thematically consistent are moved on to the eligibility and inclusion phases. The low percentage of retained articles indicates that there might be an imbalance in the literature about the existence of high-impact empirical studies on the use of LMSs in vocational contexts. This assists in the idea that systematic literature reviews are innovative and relevant. This carefully selected and prepared set of texts forms the foundation of an in-depth exploration of themes that might provide insight into the complexities as well as the general trends in the use of LMS technologies beneath TVET systems.

Table 3: The Selection Criterion is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2025	< 2025
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Subject	Social Science, Computer Science, Mathematics and Engineering	Besides Social Science, Computer Science, Mathematics and Engineering

Eligibility

Eligibility assessment phase is a crucial element of the process of conducting a systematic review study according to the PRISMA guidelines. At this point, all the records that have been selected are thoroughly reviewed to make sure that they fit the research question, correspond with the developed concept, and possess easily retrievable data. Among the 156 records retrieved during the initial phase, 129 records have successfully undergone the eligibility assessment procedure. This assessment involves a thorough review of the article title, abstract, and full content to assess its direct relevance to the integration of the LMS approach in the context of vocational education. A total of 78 articles were omitted because they did not meet the outlined criteria. Some of them do not pertain to the field of vocational education or educational technology, while some contain titles and abstracts that do not adequately explain the focus of the study. In addition, several articles are not fully accessible or do not include clear empirical and methodological data. These criteria for rejection are set to ensure the accuracy and integrity of the analysis in the literature review conducted, as well as retaining only articles that prove strength in terms of methodology and theme determination.

After a stringent review, 51 high-quality, research-based papers were selected for final synthesis and inclusion. This selective yield shows that the review process followed strict methodological standards, which is in line with best practices for publishing in high-impact publications. Eliminating publications that do not have an empirical focus makes sure that the final dataset is solid enough to enable evidence-based conclusions about how LMS are used and what happens when they are used in vocational education settings. The systematic

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reduction from 8,828 to 51 records shows that the literature has been substantially improved, giving us a focused and analytically manageable body of work for topic exploration and bibliometric mapping. This result shows that we need more thorough screening methods and that there are not enough specific empirical studies available. This shows that there is a need in research at the junction of LMS adoption and vocational education. Thus, the goal of this review is to offer a real and timely involvement to the field.

Data Abstraction and Analysis

An integrative analysis approach was employed in this study as a key assessment strategy to examine and synthesize diverse research designs, specifically within the scope of quantitative methodologies. The primary objective was to identify and classify relevant themes and subthemes associated with the study focus. The process began with systematic data collection, serving as the foundational phase for theme development. As illustrated in Figure 1, the authors conducted a thorough review of 51 selected publications, carefully analysing their content to extract insights and claims pertinent to the study's objectives related to the use of LMS in vocational education.

Subsequently, the authors evaluated significant existing research within this domain, paying close attention to methodological approaches and key findings across studies. Collaborative efforts among the authors facilitated the construction of meaningful themes grounded in empirical evidence. Throughout the analysis process, a reflective log was maintained to document analytical decisions, emerging interpretations, uncertainties, and contextual observations that informed the data interpretation. In the final phase, the team conducted a comparative analysis to identify and resolve any discrepancies in the theme development process. Any conceptual disagreements that arose were addressed through collaborative discussion to ensure consensus and consistency in the thematic framework. The expert review phase helped ensure each sub-theme’s clarity, importance, and adequacy by establishing domain validity. Adjustments based on the discretion of the author based on feedback and comments by experts have been made. The questions are as follows below:

1. What institutional, technical, and user-related factors influence the successful adoption and sustained implementation of LMS in vocational education environments?

2. How do vocational educators integrate digital tools and instructional design principles within LMS platforms to enhance learner engagement and skill-based competency development?

3. In what ways do learning analytics and AI-driven personalization features within LMS environments support adaptive learning, performance monitoring, and individualized instructional pathways in vocational education?

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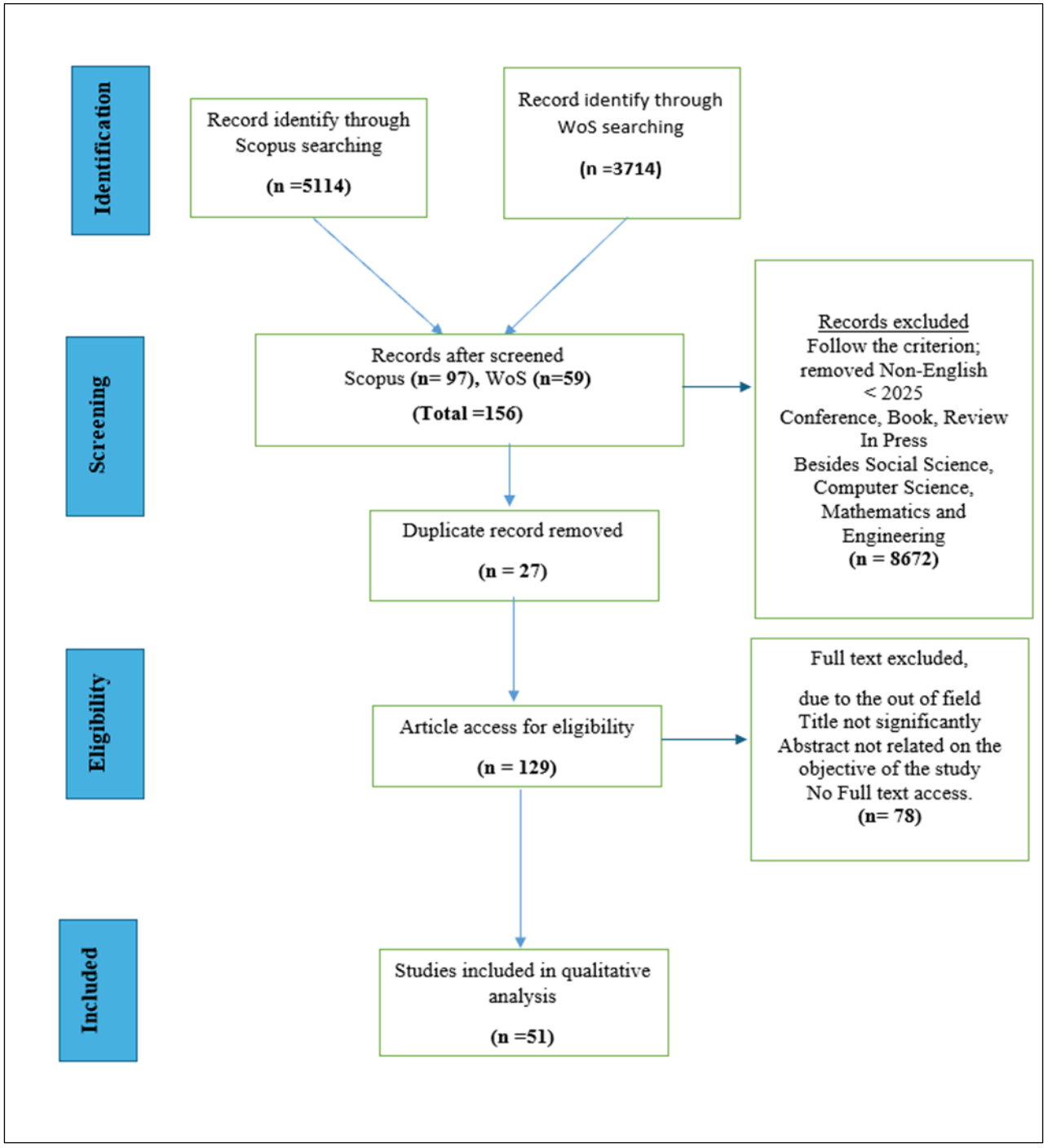

Figure 1 : Flow Diagram Of The Proposed Searching Study (Page et al., 2021)

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Result and Discussion

Adoption, implementation, and user experience of LMS, pedagogical innovations, digital learning tools, and instructional design, and learning analytics, artificial intelligence, and personalization in LMS environments are the three themes that group the 51 papers.

Adoption, Implementation, and User Experience of Learning Management Systems (LMS)

The evaluation of 13 selected abstracts highlighted three major topics concerning the application of Learning Management Systems (LMS) in colleges and universities and vocational training which are acceptableness, implementation, and user experience. This description synthesises significant observations into many coherent paragraphs, illustrating current concerns and shared findings from the varied studies.

One of the primary issues recognised by numerous institutions is the unequal efficacy of LMSs due to physical limitations and varied levels of digital competence. The fast transition to online education in countries such as Thailand and Ghana has highlighted the existing digital divide. The study conducted by Somabut et al. (2025) demonstrated that despite some schools possessing a strong ICT infrastructure and access to such tools as Moodle and Google Classroom, barriers such as a lack of stable internet connections and insufficient digital literacy levels among students continue to undermine the success of LMS implementation. Ghansah (2025) found similar challenges in other higher educational institutions in Africa, where limited access to the internet and inadequate digital literacy of students and staff are major challenges. In fact, even the well-designed LMS efforts have been hindered by these latent limitations. Güntem and Kılıç (2025) highlighted that the lack of coordination of LMSs with the websites of the institutions in Northern Cyprus threatens the sustainability of the systems and their use by people, and it is crucial to implement a more comprehensive and sustainable digital strategy. A common subject is to the level of user satisfaction and the usefulness of the LMS system. Technical as well as interpersonal factors were also identified to be very significant in influencing student participation. A research conducted by Llamas et al. (2025) employing a qualitative methodology identified several deficiencies in user experience, encompassing usability, communication channels, and technical assistance inside Moodle-based platforms. In an additional investigation, Jasim et al. (2025) demonstrated using structural modelling that service quality, encompassing technical, interpersonal, and administrative parameters, greatly impacted students' assessments of the online platform's usefulness. This conclusion is supported by Almusfar (2025), who highlighted that system reliability and adaptive learning capabilities significantly enhance student satisfaction and loyalty. These studies collectively affirm that enhancements in system responsiveness, user interface design, and individualised features are crucial for the optimal utilisation of LMS by students.

The variation in perspectives between students and instructors concerning the efficacy of LMSs is a significant matter. Simon et al. (2025) found out that some students and professors still use other tools even though the use of Moodle increased during the pandemic because of their dissatisfaction with the communication features of the platform. Mohammed et al. (2025) in another study found that students and staff had a difference in their perception of the use of Blackboard, with students being disappointed in having little interaction with peers and frequent delays in updating the material. Desai and Patwardhan (2025) attributed this problem to the fact that the skills of instructors to properly use the features of LMSs have remained poor. They suggested that the integration of LMSs should be aligned with pedagogical models such as the ARCS model in order to increase the student engagement level. The given data,

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therefore, indicates that the effectiveness of LMS usage depends on the development of technologies and requires correlating with pedagogical approaches and the continuous process of training.

Several studies have revealed the possibilities of LMSs in promoting wider, educational objectives, such as language acquisition and development of employable skills. Marwan (2025) stressed that the Cambridge Online platform supports self-directed English learning in vocational students, exemplifying that a well-structured LMS can potentially improve learning in non-conventional educational settings. The research by Sutapa and Halim (2025) has proposed PetraVerse, a gamified Learning Management System, which proved to be a successful tool to increase students' motivation, mastering new skills, and user satisfaction. At the same time, Imjai et al. (2025) found out that digital adaptability and employability skills of Generation Z students in Thailand can be promoted through LMS and collaborative tool integration. All these results confirm the claim that LMSs are not merely a platform to deliver the material but also an important part of the overall development of students and their digital competence.

Pedagogical Innovations, Digital Learning Tools, and Instructional Design

The analysis of abstracts devoted to the topic of Pedagogical Innovations, Digital Learning Tools, and Instructional Design shows specific trends of the integration of LMS and other digital tools in different educational contexts. The findings and discussion of the studies incorporated into the paper show general tendencies in pedagogical implementation of virtual learning environments, enhancement of critical thinking and 21st-century skills, and development of immersive and interactive instructional models.

A critical finding involves the use of virtual labs and immersive environments to simulate real learning experiences with technical and scientific disciplines. As demonstrated by Mustari & Nugroho (2025), Sharifkhani et al. (2025) and Tatenov et al., (2025), virtual labs are highly beneficial in terms of the interaction of learners with concepts, interactivity with complex content, including physics and inorganic chemistry. Additionally, Vieira & Medeiros (2025) investigated the viability of immersive network laboratories, highlighting their effectiveness in simulating physical laboratory interactions for computer networking topics. These studies together demonstrate that whereas digital laboratories improve accessibility and safety, issues such as cognitive load, digital literacy, and limited cooperation persist. Nevertheless, the research confirms that hybrid methodologies combining virtual laboratories with practical activities can substantially enhance learning outcomes.

A significant issue is the use of LMS in promoting blended and collaborative learning methods, especially via increased engagement, multimedia resources, and scaffolding techniques. Alian & Mohamed (2025) and Giang et al., (2025) stated the effect of LMS-based blended learning in English as a Foreign Language (EFL) contexts, exhibiting enhancements in academic performance and vocabulary acquisition. Chang and Hwang (2025) further developed this by implementing a metaverse-enhanced BSFE model that promoted higher-order thinking and case-handling proficiency. Similarly, Hidayati et al., (2025) and Sumardi et al., (2025) discovered that LMS-integrated civic and ESP courses favourably influenced students' communication skills, self-efficacy, and reasoning capabilities. These examples illustrate that effectively designed LMS activities may foster autonomous learning, problem-solving, and significant student involvement when linked with certain educational objectives.

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A considerable body of research has focused on the enhancement of transferable and cognitive abilities using technology-mediated training. Mardiana et al., (2025), Thammaariyasakun et al., (2025) and Yüksel et al., (2025) demonstrated that digital tools in educational robotics, android-assisted learning, and engineering design processes, respectively, fostered 21st-century competencies such as creativity, critical thinking, and collaboration. Shadiev et al., (2025) corroborated these findings, demonstrating that the integration of immersive technology with interactive tactics markedly enhanced students' intercultural ability in virtual learning settings. Herodotou et al., (2025) validated this by emphasising the necessity for educational reconfiguration of virtual instruments, such as virtual microscopes, to promote higher-order cognitive processes.mThese studies underscore that effective digital training necessitates a congruence between technology capabilities and pedagogical models to adequately foster skill development.

The analysed abstracts demonstrate that LMS and related technologies may efficiently facilitate various teaching objectives across different contexts and disciplines. The incorporation of digital learning environments, whether via immersive virtual laboratories, blended education, adaptive tools, or metaverse-enhanced collaboration, must be anchored in intentional instructional design and attuned to learner requirements. The research confirms the revolutionary potential of these advances, while recognising the ongoing issues of access, digital preparedness, and instructional support.

Learning Analytics, Artificial Intelligence, and Personalization in LMS Environments

The integration of Learning Analytics (LA), Artificial Intelligence (AI), and personalization LMS is increasingly reshaping digital education. These technologies in education have been researched in plenty of studies that have examined their different implementations and effects. The review of sixteen recent works shows a number of essential trends and emerging topics related to technological innovation, ethical aspects, and educational effectiveness.

Much emphasis has been given to how analytics and machine learning can be used to maximize engagement and academic performance. Karthikeyan et al. (2025) proved the use of log data of LMS to track engagement and interpersonal skills, and visualizations assisted pedagogical adjustments. Similarly, Rafiq et al. (2025) employed machine learning models using behavioral data to predict academic performance, identifying specific LMS interaction features (e.g., login frequency, test submission rates) as reliable predictors. Alowayr (2025) reinforced this by reporting that LA can detect at-risk students and support timely interventions, although institutional barriers continue to limit broader adoption. These studies collectively emphasize the operational value of learning analytics in data-informed educational decision-making.

Personalization and adaptive learning approaches have also emerged as effective strategies. Alghamdi (2025) examined how blending self-paced platforms with LMS delivery enhanced programming skills and motivation, finding statistically significant improvements. Lin and Hung (2025) explored a synergy of AI with gamified scientific argumentation and scaffolding, reporting increased student motivation and improved construction of arguments when AI was comprehensively integrated. Likewise, Dong et al. (2025) presented a virtual AI-powered platform in archival science that significantly improved student confidence and AI literacy. These results highlight the potential of AI in fostering more individualized, context-aware, and engaging learning environments.

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Several researchers also examined ethical concerns and personalization risks. Majjate et al. (2025) addressed how transparency in AI recommendation systems affects student trust and engagement, noting that while transparency is essential, too much disclosure may induce cognitive overload and reduce trust. Labrović et al. (2025) analyzed engagement patterns using clustering and emphasized the pedagogical implications of automated vs. human-led interventions. Their findings reflect a need for ethical and pedagogically grounded AI design. Atabay and Çakıroğlu (2025) echoed this through their mapping of LMS interactions to self-regulation skills, identifying that not all interaction types support learning equally, suggesting targeted AI interventions should be cautiously applied.

Emerging technologies for content personalization and intelligent tutoring systems are also a dominant theme. Alshaya (2025) proposed a deep learning framework integrating sentiment analysis and LSTM networks for emoji placement in LMS content, achieving over 90% accuracy in contextual content augmentation. Alier et al. (2025) introduced LAMB, a modular AI assistant framework for LMS, providing educators with tools for building policy-compliant, scalable AI tutors using retrieval-augmented generation. Mzwri and Turcsányi-Szabo (2025) assessed a generative AI course in prompt engineering, highlighting strong gains in learner autonomy and English proficiency, especially with guided tool use. These studies collectively reinforce the promise of AI for personalized and human-like academic support while acknowledging scalability, ethical oversight, and teacher control as essential design principles.

Besides cognitive benefits, AI-enabled LMS contexts are associated with the improvement of reflective thinking and computational abilities. Omeh et al. (2025) determined that AI-driven collaborative learning enhances algorithmic thinking and problem-solving skills in students participating in a programming course. Law and Storrar (2025) demonstrated that digital badges, a type of gamified AI interaction, identify achievements and increase the motivation of students to stay actively engaged. This conclusion was confirmed by Fitrah et al. (2025), who revealed the fact that the integration of LMS with digital skills, in particular, influences the Technology Pedagogical Content Knowledge (TPACK) of pre-service mathematics instructors significantly. This research proves the potential of AI-based systems to advance educational purposes, including skill development, increased motivation, and professional development.

In a nutshell, the results of the well-reviewed study show that the integration of AI, learning analytics, and personalisation functionalities into the LMS context can significantly increase student engagement, consistency of instruction, and achievement of learning objectives. There are concerns about the possible danger of over-automating and the need to have human control, ethical design, and context-sensitive adaptation. Future research must prioritise the equilibrium between algorithmic precision and instructional significance, ensuring that technology effectively, securely, and ethically empowers educators and students.

Conclusion

This review examined how LMS are used in vocational teaching and learning. Following PRISMA procedures, we searched Scopus and WoS for empirical studies published in 2025; fifty-one peer-reviewed articles met the criteria and were thematically analysed to address three questions on LMS use, pedagogical innovation, and emerging technologies.

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First, Adoption, Implementation, and User Experience exposed institutional and infrastructural constraints, uneven digital readiness, usability limits, and variable staff–student competencies. These conditions shape not only initial uptake but also sustained use, signalling that platform decisions must be paired with support structures and context-aware implementation.

Second, Pedagogical Innovations and Instructional Design showed that aligning LMS features with contextualised strategies strengthens blended learning and engagement, especially when gamification is mapped to competency standards (not added superficially) and microlearning sequences enable spaced practice and skills consolidation. Complementing this, mobile learning is pivotal for access and continuity in TVET, enabling on-the-job reinforcement, participation in offline/low-bandwidth settings, and timely micro-assessments.

Third, Learning Analytics, Artificial Intelligence, and personalization highlighted the promise of AI-driven LMS, adaptive sequencing, automated feedback, and predictive risk alerts, while underscoring the need for transparent models, valid skill proxies for practical tasks, and ethical safeguards. Taken together, the review contributes a structured framework that bridges theory and practice by foregrounding pedagogical alignment, user-centred design, and technological adaptability; it clarifies how AI, gamification, mobile-first delivery, and microlearning can jointly support vocational skill development when embedded within competency frameworks and authentic assessment.

Practically, findings inform targeted professional development (designing gamified tasks, chunking microlearning for mobile, interpreting AI/analytics responsibly) and institutional policy on equitable infrastructure, mobile access, and data governance. Limitations include the English-language focus and single-year scope. Future work should widen timelines, include non-English databases, and conduct cross-cultural, longitudinal evaluations of AI-augmented, gamified, mobile-first, microlearning-oriented designs, with outcomes that capture skill attainment, workplace transfer, and educator workload.

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