

Leveraging Ai-Driven Online Learning Management Systems to Improve Teaching and Learning in Medical Education: Insights from the Medical Library

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Received: September 23, 2025; Accepted: September 30, 2025; Published: October 07, 2025

ABSTRACT

Introduction: This study explores the opportunities and challenges of integrating AI-driven online learning management systems (OLMS) within medical libraries to enhance medical education. The study examines how AI-enhanced OLMS can support personalized learning, expedite information retrieval, and optimize content discovery for researchers, medical students, and healthcare professionals.

Objective: This study aims to advance AI-based OLMS through medical libraries to enhance teaching and learning in medical education.

Method: The Human-Organization-Technology Fit (HOT-Fit) framework, which evaluates how users, organizational structure, and technology fit while implementing AI-driven OLMS, serves as the foundation for the study's methodology. 33 papers met the inclusion criteria after a systematic literature review using PRISMA guidelines sourced 3,718 records from Web of Science, PubMed, Scopus, and IEEE Xplore between 2015 and 2025.

Results: Findings suggest AI-driven OLMS can automate resource curation, expedite information retrieval, and offer adaptive learning pathways that are customized to meet the needs of each user. The findings also point to important factors that facilitate personalized learning experiences such as intelligent search capabilities and AI-based recommendations, which enable users to access relevant studies, clinical guidelines, and case materials.

Conclusion: The result of this study, although constrained by a 10-year literature scope, underscores the potential of medical libraries as pivotal hubs for AI-driven educational support in medical education. Consequently, this study offers actionable insights for educators, librarians, and administrators in designing and implementing effective AI-driven OLMS to enhance teaching and learning in medical environments.

Keywords: AI-Driven Learning Management Systems, Teaching and Learning, Medical Education, Medical Libraries, Systematic Literature Review

Introduction

The integration of Artificial Intelligence (AI) in education has revolutionized learning methodologies, particularly in medical education, where personalized learning, real-time information retrieval, and adaptive content recommendations are critical. AI-driven Online Learning Management Systems (OLMS) enhance teaching and learning by leveraging intelligent search, automated content curation, and data-driven recommendations (Gautam, 2024). Meanwhile, medical libraries, as knowledge hubs, play a

crucial role in facilitating AI-based learning solutions, enabling students, educators, and healthcare professionals to efficiently access relevant academic and clinical resources [1].

To support effective teaching and learning, AI-powered tools such as machine learning algorithms, natural language processing (NLP), and predictive analytics enhance educational experiences by providing real-time feedback, intelligent tutoring systems, and automated content delivery [2]. In medical education, AI applications support interactive simulations, virtual patients, and personalized learning pathways, allowing students to engage in evidence-based, self-directed learning [3,4]. AI-driven OLMS analyze user behavior, learning patterns, and engagement metrics

Citation: Adamu Sa'ad Madaki, Abdulghader Abu Reemah A Abdullah, Ethar Alsharaf. Leveraging Ai-Driven Online Learning Management Systems to Improve Teaching and Learning in Medical Education: Insights from the Medical Library. J Med Clin Nurs Stud. 2025. 3(5): 1-6. DOI: doi.org/10.61440/JMCNS.2025.v3.89

to provide customized educational experiences [5]. These systems integrate with digital libraries, medical databases, and clinical case studies, enhancing the accessibility and relevance of educational materials for medical students and practitioners.

Medical libraries serve as vital knowledge repositories, providing access to research publications, textbooks, and clinical guidelines. In the digital age, their role has expanded to include information literacy training, research support, and the integration of advanced digital tools [5]. By incorporating AI-driven OLMS, medical libraries can streamline access to relevant studies, improve knowledge collaboration, and support evidence-based learning [3]. AI applications in medical libraries include intelligent search engines, automated indexing, and personalized content recommendations. AI-powered chatbots assist users in navigating complex medical databases, while NLP techniques enable efficient literature retrieval and summarization [6]. Additionally, predictive analytics help librarians understand user needs, optimize resource allocation, and improve decision-making in medical education support [1].

Despite the potential of AI-driven OLMS, challenges such as implementation barriers, lack of institutional readiness, and concerns over user adaptability persist [7]. Adoption hurdles include data privacy concerns, high implementation costs, resistance to change, and technical limitations (Muhlheim et al., 2023). Furthermore, a lack of AI literacy among educators and librarians can hinder effective deployment [8]. Addressing these challenges requires institutional support, training programs, and strategic policy frameworks to ensure the seamless integration of AI into medical education through medical libraries.

This study seeks to bridge this gap by exploring the role of AI-enhanced OLMS in medical libraries. Specifically, it addresses the following questions: (1) How can AI-driven OLMS improve personalized learning in medical education? (2) What are the challenges and facilitators of AI adoption in medical libraries? Using the Human-Organization-Technology Fit (HOT-Fit) framework, this study evaluates AI-driven OLMS implementation in medical libraries. The findings will inform educators, librarians, and policymakers on best practices for optimizing AI-powered learning environments, ultimately enhancing medical education through innovative technological integration.

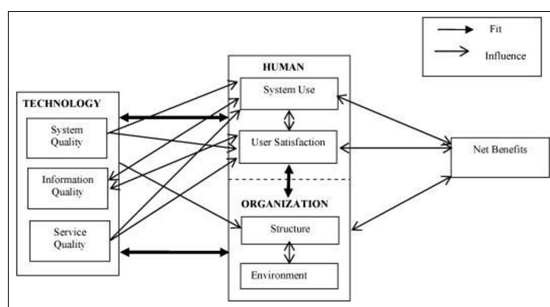


Figure 1: Human-Organization-Technology Fit (HOT-Fit) framework
Source: [9]

Methodology

This study adopts the Human-Organization-Technology Fit (HOT-Fit) framework to evaluate the alignment between human (users), organizational (institutional structure), and technological (AI-driven OLMS) factors in medical libraries. The HOT-Fit model is widely used to assess the success of technology adoption in healthcare and educational institutions by examining factors such as system quality, information quality, and organizational readiness [10]. This framework provides a structured approach to analyzing the effectiveness of AI-driven OLMS in enhancing medical education.

A Systematic Literature Review (SLR) was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PRISMA ensures a rigorous selection process by systematically identifying, screening, and analyzing relevant studies [11]. The review focused on AI-driven OLMS applications in medical education, particularly their implementation in medical libraries. The PRISMA approach enabled a comprehensive synthesis of existing research, ensuring transparency and replicability.

As shown in Figure 2, a total of 3,718 records were retrieved from Web of Science, PubMed, Scopus, and IEEE Xplore, covering the period from 2015 to 2025. The inclusion criteria were:

1. Peer-reviewed studies on AI-driven OLMS in medical education.
2. Research focusing on AI applications in medical libraries.
3. Studies addressing technological, organizational, and human factors in AI adoption.

After screening and eligibility assessment, 33 papers met the inclusion criteria for final analysis.

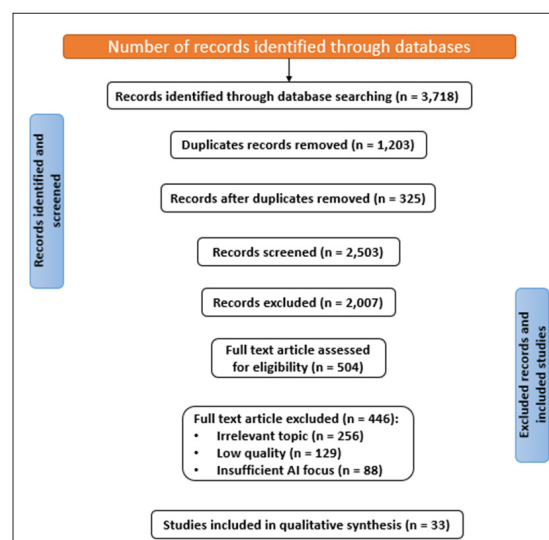


Figure 2: Prisma 2020 Flow Diagram for Systematic Reviews Based on Guidelines Outlined By [11]

Relevant data—including study objectives, methodologies, key findings, and challenges—were extracted. A thematic analysis was conducted to categorize findings into core themes such as AI-enabled personalized learning, search and information retrieval, and implementation challenges. The synthesized results

provide actionable insights for implementing AI-driven OLMS in medical libraries. This methodological approach ensures a structured evaluation of AI-driven OLMS and its impact on medical education, offering guidance for future research and policy development.

Results and Findings

Findings from the reviewed literature indicate that AI-driven Online Learning Management Systems (OLMS) significantly enhance personalized learning in medical education [12]. These systems leverage machine learning algorithms and predictive analytics to adapt to individual learning styles, knowledge levels, and preferences [13]. AI-powered OLMS assess students' progress, recommend customized study materials, and provide targeted feedback. Several studies highlight the benefits of adaptive assessments and AI-driven tutoring systems, which improve student engagement and knowledge retention [14]. By delivering personalized learning experiences, these systems ensure that medical students and healthcare professionals receive relevant, case-based learning materials tailored to their specific needs [15].

The study also found that AI has revolutionized search and information retrieval in medical libraries by integrating natural language processing (NLP) and semantic search capabilities [16]. The findings suggest that AI-driven OLMS can automate literature searches, summarize key findings, and enhance access to medical databases. Intelligent search tools utilize context-aware AI models to interpret user queries, ensuring highly relevant and accurate search results [17]. AI-based recommender systems further filter and suggest high-impact research articles, clinical guidelines, and case studies, reducing the time required for students and educators to find relevant resources [18]. The implementation of AI in medical libraries has been shown to improve research efficiency and decision-making in medical education.

Another key finding is that the integration of AI-driven OLMS into medical libraries supports the development of adaptive learning pathways that guide learners based on their performance, interests, and progress [19]. Studies reveal that AI can automate content curation, ensuring that medical students receive dynamic, up-to-date educational resources [20]. AI-based content recommendation engines analyze user engagement patterns and learning histories to provide customized course materials, e-books, video lectures, and clinical simulations [21]. This fosters a more interactive and immersive learning experience. Additionally, AI-driven OLMS facilitate competency-based education, allowing students to focus on mastering essential medical skills before progressing to more complex topics.

However, several factors influence the successful implementation of AI-driven OLMS in medical libraries. Findings suggest that technological infrastructure, organizational readiness, AI literacy among educators, and data privacy concerns play a crucial role in AI adoption [22,23]. Institutions with strong IT support and investment in AI training demonstrate higher adoption rates. Additionally, ethical concerns regarding data security and algorithmic bias must be addressed to ensure reliable and equitable AI-driven education. The study highlights the need for policy frameworks, librarian training, and stakeholder collaboration to maximize AI's potential in medical libraries.

Overall, the results underscore AI's transformative role in enhancing teaching, learning, and research in medical education through intelligent automation, personalized learning, and efficient knowledge management. Medical libraries serve as crucial facilitators in this process, providing the infrastructure and resources needed to integrate AI-driven solutions effectively [24,25].

Table 1: Findings Categorized Based on Thematic Analysis

Theme	Findings	Source
Personalized Learning	- AI-driven OLMS adapt to individual learning styles, knowledge levels, and preferences - Machine learning and predictive analytics assess progress, suggest customized study materials, and provide targeted feedback - Adaptive assessments and AI-driven tutoring systems enhance engagement and knowledge retention - Personalized learning ensures relevant, case-based medical education	(Labib & ElSabry, 2025; Pantazatos et al., 2023)
Search & Information Retrieval	- AI integrates NLP and semantic search to automate literature searches and summarize key findings - Context-aware AI models interpret queries for accurate search results - AI-based recommender systems filter and suggest high-impact research articles, clinical guidelines, and case studies - Enhances research efficiency and decision-making	(Sivarajkumar et al., 2024)
Adaptive Learning Pathways	- AI automates content curation to provide dynamic, up-to-date educational resources - AI-based recommendation engines analyze user engagement to customize course materials, e-books, video lectures, and clinical simulations - Supports competency-based education by guiding students to master essential skills before progressing to complex topics	(Aleven et al., 2016; Strielkowski et al., 2024)

Implementation Challenges	- Key factors influencing adoption: technological infrastructure, organizational readiness, AI literacy, and data privacy concerns - Institutions with strong IT support and AI training show higher adoption rates - Ethical concerns include data security and algorithm bias - Policy frameworks, librarian training, and stakeholder collaboration are needed for successful implementation	(Chatikobo & Pasipamire, 2024; Pedro et al., 2019)
Impact of AI in Medical Education	- AI enhances teaching, learning, and research through automation, personalized learning, and efficient knowledge management - AI-driven OLMS transform medical education by improving engagement, accessibility, and decision-making	(Monyela & Tella, 2024; Rane et al., 2023)

Discussion

The findings of this study highlight the transformative role of AI-driven Online Learning Management Systems (OLMS) in enhancing medical education through medical libraries. Medical libraries are evolving from static repositories of information into dynamic digital learning hubs where AI-powered tools facilitate efficient knowledge retrieval, personalized learning, and adaptive education [26]. AI-driven OLMS enable medical students, educators, and researchers to access curated, high-quality resources tailored to their learning needs [27]. This shift has significant implications for self-directed learning, competency-based education, and evidence-based medical practice, ensuring that learners remain updated with the latest medical advancements.

Additionally, the role of medical librarians is shifting toward that of AI-assisted knowledge facilitators, requiring them to develop new competencies in managing AI-powered systems, curating digital content, and assisting students in AI-enhanced learning environments. Institutions that successfully integrate AI-driven OLMS into medical libraries are likely to see improvements in student engagement, research productivity, and medical training outcomes.

These findings suggest that AI-driven OLMS offer numerous opportunities, including automated content curation, intelligent search capabilities, adaptive assessments, and data-driven decision-making [28]. By providing real-time feedback, tailored study plans, and AI-recommended clinical cases and research articles, these systems enhance learning efficiency [28]. AI also facilitates collaborative learning through discussion forums, virtual tutors, and chatbot-assisted study guides.

However, several challenges remain in the adoption and implementation of AI-driven OLMS in medical libraries. These include high infrastructure costs, resistance to AI adoption among educators, data privacy concerns, and ethical issues related to AI bias [29]. Additionally, ensuring interoperability between AI-driven OLMS and existing library systems remains a technical hurdle [30]. Addressing these challenges requires investment in AI training, the development of policy frameworks for ethical AI use, and institutional collaboration.

Traditional Learning Management Systems (LMS) primarily rely on static content delivery and manual content management, whereas AI-driven OLMS provide personalized learning experiences, real-time analytics, and automated recommendations. (Gautam, 2024). This underscores the need

to adopt AI-driven OLMS within the framework of digital libraries. Unlike conventional medical databases, AI-driven OLMS integrate machine learning algorithms that enhance search precision, summarize large datasets, and suggest the most relevant learning materials [29,30]. Compared to existing e-learning platforms, AI-driven OLMS offer a more adaptive, interactive, and competency-focused approach tailored to individual learners[31].

Against this backdrop, this study proposes an expanded HOT-Fit framework, incorporating additional factors that influence the adoption of AI-driven OLMS in medical libraries. The proposed model builds on the three major components of the HOT-Fit framework—Human, Organization, and Technology—while introducing an Impact Evaluation factor.

1. Human Fit: AI literacy and training for educators and librarians, user readiness and adaptability, ethical and privacy concerns in AI implementation, and student engagement and satisfaction.
2. Organization Fit: Institutional support and strategic policy development, financial and resource allocation for AI integration, organizational culture and resistance to change, and collaboration among educators, librarians, and administrators.
3. Technology Fit: AI algorithm transparency and interpretability, system usability and user-centered design, integration with digital medical libraries and clinical databases, and data security and compliance with medical standards.
4. Impact Evaluation: Learning outcomes and academic performance metrics, AI-driven knowledge collaboration and research productivity, and longitudinal assessment of AI implementation success.

By incorporating these additional factors within the HOT-Fit framework, this study provides a comprehensive evaluation of AI-driven OLMS in medical libraries. The insights gained will support the development of best practices, ensuring effective and sustainable AI adoption in medical education.

Conclusions

This study explored the integration of AI-driven Online Learning Management Systems (OLMS) in medical education through the lens of medical libraries. Findings indicate that AI-driven OLMS personalize learning experiences, enhance information retrieval, and optimize content recommendations for medical students, educators, and researchers. AI-powered intelligent

search systems improve efficiency in accessing clinical guidelines, research articles, and case-based learning materials, while adaptive learning pathways ensure that students receive tailored educational resources based on their needs. However, the successful implementation of AI-driven OLMS depends on several critical factors, including technological infrastructure, institutional readiness, and ethical considerations related to AI bias and data privacy.

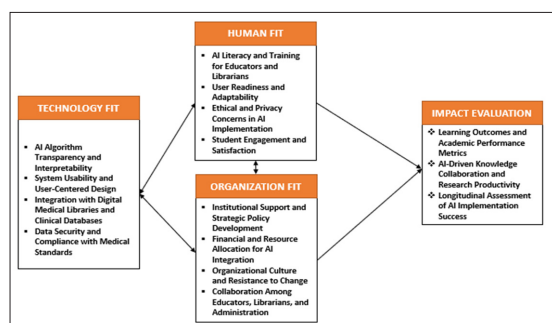


Figure 3: Proposed Model

For educators, AI-driven OLMS offer opportunities to enhance medical training through automated assessments, real-time feedback, and personalized learning trajectories. By leveraging AI tools, medical instructors can track student progress, identify knowledge gaps, and provide targeted interventions to improve learning outcomes.

For medical practitioners, AI-powered OLMS facilitate continuous professional development (CPD) by offering adaptive learning modules, case-based simulations, and AI-curated medical literature. This ensures that healthcare professionals remain updated on the latest medical advancements and best practices.

For medical librarians, AI integration transforms their role into knowledge facilitators, assisting students and researchers in navigating AI-enhanced medical databases, optimizing literature searches, and curating digital resources tailored to learning needs. Institutional support for AI training programs for librarians is essential to ensure they can effectively manage and utilize AI-driven systems.

Despite these advantages, this study has some limitations. Firstly, the scope is restricted to literature published between 2015 and 2025, which may exclude emerging AI developments beyond this period. Secondly, institutional variations in AI adoption were not extensively analyzed, limiting the generalizability of findings across different medical schools and libraries. Lastly, while this study highlights key challenges in AI adoption, empirical validation through real-world AI implementation case studies remains an area for future research.

Future Research Direction

Future research should focus on empirical validation by conducting real-world AI-driven OLMS implementation studies in medical libraries. This would provide quantitative and qualitative insights into the effectiveness of AI in improving learning outcomes. Additionally, studies should explore the long-term impact of AI adoption on medical education and clinical training, assessing how

AI-enhanced learning environments influence critical thinking, decision-making, and knowledge retention.

Furthermore, research on AI ethics, data security, and algorithmic bias in medical education is necessary to develop guidelines that ensure fair, transparent, and responsible AI adoption. Collaborative studies between medical institutions, AI developers, and policymakers will be crucial in designing AI-driven OLMS that align with educational best practices and regulatory frameworks.

Final Thought

Overall, AI-driven OLMS hold immense potential in transforming medical education and library systems, provided that institutions adopt strategic implementation frameworks, address ethical concerns, and promote AI literacy among stakeholders. Despite its limitations, this study provides valuable insights for medical educators, librarians, and policymakers seeking to leverage AI-driven OLMS to enhance teaching, learning, and research in medical education.

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