



EVALUATING THE IMPACT OF AI-DRIVEN LEARNING MANAGEMENT SYSTEMS ON TEACHING AND LEARNING IN HIGHER EDUCATION

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ABSTRACT

This study examines the effects of Artificial Intelligence (AI)-based Learning Management Systems (LMS) on teaching and learning in tertiary education. With challenges like large class sizes, diverse learning needs, and adapting to evolving educational environments, AI technologies in LMS are becoming increasingly popular to address these issues. AI-powered LMS offers personalized learning paths, automated processes, and real-time feedback, transforming education. The objective of this paper is to evaluate the impact of AI-based LMS on teaching capabilities, student engagement, and performance. Using a mixed-methods research approach, data were collected through surveys (quantitative) and interviews (qualitative), alongside usage analytics from the LMS. Results show that AI-based LMS are moderately effective in improving learning outcomes and engagement, although challenges remain in instructor adoption, content customization, and technological support. The study highlights the need for continuous professional development for educators, robust technical infrastructure, and ethical considerations in AI use. Best practice guidelines for integrating AI in education are provided, aiming to improve teaching practices and student learning experiences.



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1. INTRODUCTION, CONTEXT AND RELEVANCE

The teaching and learning environment in higher learning is currently under a huge shift with regard to increased integration of complex technology. The growing need to have personalized, efficient and scalable applications is facing a challenge on the traditional model of teaching and learning. Some of the

challenges facing institutions are crowded classrooms, diverse student needs, and the growing need of flexible and available learning places. Such matters are complicated by the fact that instructors require being very active to involve the pupils in the learning process effectively in addition to dealing with administration matters.

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On the backdrop of these altering demands, the concept of Artificial Intelligence (AI) has emerged as a promising tool in revolutionizing the education process. Higher learning institutions are adopting AI-driven Learning Management Systems (LMS) in an attempt to enhance the teaching and learning experience. Such systems use AI algorithms to provide personal journeys of learning, computerize parts of the administration, provide us with real-time feedback, and help make data-driven decisions.

The application of Artificial intelligence on Learning Management systems will have significant impact on higher education due to its ability to enhance more dynamic and flexible environment with students at the center. It commits itself to address such problems as the large size of classes, varying levels of learning pace, and the need to timely respond to problems in the performance of the students. Additionally, Learning Management Systems powered by AI can provide teachers with the information about student behavior, engagement rates, and their educational outcomes, therefore, empowering them to implement more accurate pedagogical strategies.

However, even though LMS, powered by AI, have multiple benefits, its effects on pedagogy and learning are currently being explored. It is necessary to understand how such systems affect student engagement, educational outcomes, and workload of the teacher, so as to maximize effectiveness. The purpose of this research is to evaluate the impact of Learning Management Systems powered by AI on the pedagogy and learning in the context of higher education and provide knowledge on their efficiency, issues, and possibilities in the future.

The use of Artificial Intelligence (AI) in high education is changing the dynamics of teaching and learning as it is increasingly being integrated in learning institutions. Intelligent tutoring systems, machine learning, adaptive learning platforms are some examples of artificial intelligence technologies being leveraged to enhance personal literacy whereby one can use it to enhance his/her learning and better the administrative processes. These developments may, however, be considered an impediment as well because they will introduce ethical issues, data privacy, and algorithmic bias alongside improved learning. It is vital to understand how Learning Management Systems (LMS), which are powered by AI, affect the process of education and the engagement of students to optimize their use. In this work, the authors aim to evaluate these implications, as well as provide recommendations on how to be reasonable and tactical in the integration of AI in higher education (Kazimova et al., 2025).

The recent scene of higher education is rapidly changing, and the institutions are constantly turning

toward Artificial Intelligence (AI) to address challenges and enhance the learning journey. The applications of the AI technologies to basic functions, including individualized learning, intelligent tutoring systems, and computerized administrative tasks, are being introduced. The technological improvements also improve the teaching procedures and streamline the processes making institutions efficient and responsive. Since the future of higher education is becoming more and more dependent on AI, the effects of AI on both educational approaches and operations of institutions should also be understood in order to ensure that AI is deployed responsibly and successfully (Deri et al., 2024).

It is well recognized that Artificial Intelligence (AI) when implemented in a higher education system has the capacity to enhance learning as well as prepare students to solve future challenges. Triggering this, artificial intelligence technology is being employed to foster personalized adaptive learning practices that further critical thinking and participation. The use of AI raises concerns with academic integrity, ethics, and data issues. It is imperative to address these concerns, concurrently aligning AI applications to course objectives in order to maximize its benefits. Notwithstanding these obstacles, AI is positioned to revolutionize pedagogical approaches, enhancing student achievement and contentment (Maphalala & Ajani, 2025).

The use of Artificial Intelligence (AI) in higher education rose to a global level worldwide in 2023 as a result of the advent of generative AI. This shift will ensure that there are profound changes in teaching and learning, where the AI can play many roles, including curriculum content and the means of enhancing educational experiences. The problems faced by the higher education institutions include globally unequal accessibility to AI, ethical crowd sourcing, as well as the need to find and sustain differentiated integration. With the changes in the capacities and employment markets due to artificial intelligence, educational enterprises need to change in order to prepare the students according to this changed environment (Pugachova, 2023).

Artificial Intelligence (AI) continues shaping the world of Information Technology (IT) higher education, and the opportunities associated therewith are quite significant concerning the improvement of learning outcomes through individualized and customizable solutions. The incorporation of AI has obstacles including issues of transparency, accountability, automated biases, and accessibility. Resolving these challenges while promoting AI proficiency, revising curriculum, and prioritizing ethical considerations is essential for the effective integration of AI in higher education. With the development of artificial intelligence, our IT students should be provided with the

opportunities to use them successfully and without abusing them (Bai, 2024).

1.1 Problem Statement

Despite the growing interest in the use of Artificial Intelligence (AI) in higher education, a major gap has remained in the research addressing the potential effect of AI-based Learning Management Systems (LMS) on the quality of pedagogy and students learning outcomes. Although AI technologies are progressively utilized to improve individualized learning and optimize administrative functions, their direct impact on instructional quality, teacher-student interactions, and academic performance remains inadequately comprehended. The recent studies often focus on the technological aspects of the integration of AI, creating a large gap when it comes to acknowledging the real effects of such systems on the educational processes and learning outcomes. This research paper aims to carry out a review of this shortage by considering the effectiveness of AI-based Learning Management Systems to improve teaching practices and student performance.

1.2 Purpose of the Study

This paper provides an attempt to evaluate the effect the AI-enabled Learning Management System (LMS) has on the pedagogical strategies, engagement, and learning achievements. The aim of this research is to assess the role of AI technologies embedded in LMS in the pattern of teaching, the effectiveness of well-planned learning experiences and the overall academic performance of students. This study seeks to explain how AI-based tools can support instructional activities, stimulate further involvement of students, and enhance the results of teaching and learning processes in higher educational settings.

1.3 Scope of the Research

This study is on integration of Learning Management Systems (LMS) using AI in universities offering both postgraduate and undergraduate programs. The main instruments to be considered in the study will be the commonly applied LMS tools, including Moodle, Blackboard, and Canvas, that include the use of AI capabilities, including customized learning journeys, adaptable evaluation, and automatic responsive feedback structures. Although this research is not confined to one particular discipline, it will evaluate the influence of such tools through varying academic discipline, such as sciences, humanities and business studies, to provide an overall perception of AI to the role of higher education.

1.4 Objectives of the evaluation

Objectives of the evaluation are:

1. To understand how the use of AI based LMS tools affect teaching efficiency, e.g. how pedagogical activities and instruction can be improved.
2. To compare the effectiveness of AI-based features in LMS with reference to engagement and participation of students in the synchronous and asynchronous learning environments.
3. To investigate the correlation of utilization of AI-based LMS technologies and student achievement with an emphasis on academic performance, retention rates, and, overall, satisfaction.
4. To discuss the faculty and student attitudes towards AI powered LMS tools and their readiness to use the system and inter regulate it with the learning process.
5. To deliver the proposals regarding the effective implementation of the AI technologies into LMS, relying on the best practices and empirical evidence.

2. REVIEW OF LITERATURE

2.1 Overview of Learning Management System

Learning Management Systems (LMS) have seen substantial evolution through the use of Artificial Intelligence (AI), resulting in major improvements compared to conventional platforms. Conventional LMS predominantly emphasize content management and student progress tracking, although they are deficient in personalization and adaptability. Conversely, AI-driven Learning Management Systems, as highlighted by Kumar et al. (2025), augment the educational experience through individualized learning, automated assessment, and predictive analytics, hence enhancing academic results. These platforms establish data-driven ecosystems that enhance pedagogical approaches and deliver more effective, customized educational assistance.

Conventional Learning Management Systems (LMS) emphasize content dissemination and administrative functions, deficient in individualized learning capabilities. Conversely, Intelligent Learning Management Systems (ILMS), as outlined in Van Vaerenbergh, S., & Suay (2022), incorporate artificial intelligence to augment conventional LMS capabilities with features such as learning analytics, intelligent tutoring systems, and predictive modeling. These developments allow ILMS to provide more dynamic, tailored, and engaging learning experiences, greatly enhancing the efficacy of online education.

According to Abbasi et al. (2024), traditional Learning Management Systems (LMSs) are becoming ineffective as they fail to accommodate varied educational requirements. AI-driven systems, such as the automated learning management system (auto LMS), improve content development by automating the generation of resources from educational films, including summaries, quizzes, and lecture notes. In contrast to conventional LMSs that necessitate manual content development, auto LMS simplifies and optimizes the process, mitigating obstacles encountered by educators and content providers.

Traditional Learning Management Systems (LMS), as articulated by Thakre (2024), are intended to administer educational content and enhance communication between instructors and students. These systems encompass functionalities such as content management, enrollment monitoring, and performance assessment. AI-driven LMS enhance the learning experience by providing individualized learning pathways, adaptive assessments, and predictive analytics, delivering tailored content and real-time feedback. These innovations offer a more dynamic and efficient methodology for teaching in contrast to conventional LMS.

Conventional Learning Management Systems (LMS) predominantly function as content dissemination platforms, exhibiting restricted personalization and adaptability, as articulated by Lavanya et al. (2024). They depend on standards like as SCORM to guarantee interoperability and gather statistics on student performance; nevertheless, they are unable to combine learning experiences from external platforms. Conversely, AI-driven LMS utilize sophisticated algorithms and technologies such as xAPI to develop dynamic, individualized learning trajectories that consider individual learning preferences and external data, thereby offering a more holistic and adaptive educational experience.

2.2 Benefits of AI in Education

Artificial Intelligence (AI) is revolutionizing education by raising student learning results, augmenting retention rates, and improving engagement, as observed by Shribala and Jhaneswaran, (2024). Significant applications of AI in education encompass Intelligent Tutoring Systems, personalized learning, and grading automation, which offer customized assistance and efficient feedback. Moreover, AI assists educators by automating administrative duties and providing real-time feedback, thereby allocating more time for instruction. Although AI has considerable benefits, additional research is required to assess its complete potential and tackle any difficulties.

Artificial Intelligence (AI) is markedly improving the educational environment through individualized learning, intelligent tutoring systems, and administrative automation, as noted by Utepbergenova (2024). Artificial intelligence facilitates customized educational experiences, adjusts to individual student requirements, and enhances engagement through the provision of pertinent and interactive materials. Moreover, it optimizes administrative functions such as grading and scheduling, enabling educators to concentrate more on instruction. AI is transforming education by improving learning possibilities and increasing student engagement.

As Zhunussov (2024) explains, the big pros of Artificial Intelligence (AI) in education include personalisation of the instruction, automation of chores, and data analytics. Artificial intelligence will make it easy to create personalised learning path, immediate feedback through intelligent tutoring system, automated assessment, and therefore increase productivity among teachers. Additionally, the data analytics skill AI possesses predicts the outcomes of the students and determines those at risk, making it easier to respond timely. These inventions improve a more customised, efficient, and engaging learning experience.

According to Iman et al. (2024) acquired benefits offered by Artificial Intelligence (AI) in education have a transcendent influence on learning personalization, data, and student interaction. Artificial intelligence makes educational experiences personalized with the use of intelligent tutoring systems and flexible learning platforms to suit personal needs leading to increased interaction and motivation. In addition, AI-based data analytics ensure that deficiencies in learning are identified and, therefore, support more effective forms of teaching and personalized education. These progressions develop an increasingly effective, interesting and personalized learning atmosphere.

As pointed by Moore and Tsay (2024), Artificial Intelligence (AI) and Large Language Models (LLMs) are transforming education by creating an individual learning experience, data analytics, and making students more engaged in learning. Artificial intelligence promotes personalized learning factors amenable to working with specific student needs, and large language models enhance teaching techniques and student interactions. Furthermore, using artificial intelligence and predictive analytics, it is also possible to identify high-risk pupils in time, being able to intervene and improve feedback systems to deliver better learning outcomes.

2.3 Previous Studies

The most crucial part, stressing the benefits of including AI in Learning Management Systems (LMS), is given by Vergara et al. (2024), who state that individual

learning experiences, student engagement, and academic performance can improve when AI is integrated into Learning Management Systems. Artificial intelligence facilitates self-directed learning and fosters fair educational access. The review highlights deficiencies in the design, assessment, and practical application of AI within LMS, underscoring the necessity for additional research on AI literacy among educators and students to properly harness its potential.

Alotaibi (2024) delineates numerous advantages of AI incorporation in Learning Management Systems (LMS), such as augmented student engagement, customized learning trajectories, and enhanced educational results via data-informed judgments. AI-LMS enhances educational quality and sustainable development by augmenting accessibility and equity. The assessment identifies deficiencies in research, including the necessity for investigations into long-term effects, scalability, equitable access tactics, and the formulation of ethical frameworks for AI in education.

Cruz Cabrera et al. (2025) emphasize the substantial increase in research about the integration of AI in Learning Management Systems (LMS), especially in relation to personalized learning and online education. Prominent themes encompass the emergence of subjects such as e-learning and ant colony optimization, with nations like China and India spearheading research initiatives. Nonetheless, deficiencies persist in the efficacy and adoption of AI-driven virtual assistants, as well as in the comprehensive examination of nascent notions such as learning styles inside LMS, indicating opportunities for further research.

Manhica et al. (2022) delineate the increasing incorporation of AI within Learning Management Systems (LMS), namely for evaluating student performance through platforms like Moodle and employing AI algorithms such as Random Forest and Neural Networks. The systematic review emphasizes significant applications but fails to address specific gaps, like the long-term impacts of AI integration in LMS and its influence on teaching practices, which are inadequately examined in the current research.

Sasikala and Ravichandran (2024) emphasize the revolutionary capacity of AI in education, concentrating on its potential to individualize learning, augment engagement, and elevate academic performance. The review additionally examines significant ethical issues, including data privacy and algorithmic prejudice. Nonetheless, many deficiencies persist in the literature, especially regarding the responsible and successful integration of AI to enhance student achievement, necessitating further investigation for a more thorough comprehension of its effects on teaching and learning.

2.4 Challenges and Ethical Considerations in AI Integration in Education

Farooqi et al. (2024) delineate various obstacles and criticisms associated with AI-driven Learning Management Systems (LMS), including issues related to data privacy and security, algorithmic bias, and the risk of excessive dependence on technology that could diminish vital human connection in education. The research also emphasizes practical obstacles, like infrastructural deficiencies and opposition from instructors, especially in poor nations. These concerns must be resolved to guarantee the responsible and efficient deployment of AI in education.

Ismail (2024) addresses critical issues associated with AI-driven Learning Management Systems (LMS), such as data privacy concerns, algorithmic bias, and excessive dependence on technology. The paper emphasizes practical instances such as the inBloom project to demonstrate privacy dangers, while also considering the possible decline in critical thinking and interpersonal engagement. The study advocates for a comprehensive strategy that encompasses policy formulation, ethical standards, and enhanced data literacy among educators to facilitate successful and responsible AI integration in education.

Jose (2024) delineates significant obstacles associated with AI-driven educational platforms, encompassing data privacy issues, algorithmic biases, and the potential for excessive dependence on technology. The study underscores potential biases in AI evaluations and recommendations, which may intensify inequities, along with the risk of weakened critical thinking and reduced human contact resulting from over reliance on AI. The report proposes for ethical AI research, stringent data control, and a balanced methodology that preserves the human aspects of teaching while incorporating technology.

Jena et al. (2024) focus on the challenges of such a Learning Management System as the AI that include bias in the algorithm, overreliance on the technology, and concerns over data privacy. They urge the potential harm of biased AI-based judgments in the educational process and the potential to restrict their application of thinking and reduce human interaction in learning situations are too dependent on AI. The paper highlights the need to develop ethical AI and have very strict data protection policies and a balanced approach, which involves the use of technology and retain the human component in instruction.

Kontche (2024) names many notable hurdles regarding AI-powered Learning Management System (LMS) with Large Language Modeling (LLM), such as the problem of privacy of data, possible spread of false information, bias of the algorithm, as well as too much reliance on

technology. The study stresses the need of strict data protection, accuracy checking system and ongoing evaluation that will help to reduce prejudice and ensure fairness. Additionally, it also underlines the importance of ensuring not only a fair access to AI resources in general but also in the underrepresented populations in order to avoid the worsening of educational gaps.

2.5 Research Gap

Major strides have been recorded in the use of AI-powered Learning Management Systems (LMS), even though much needs to be done. Even though AI has enhanced personalization, engagement, and efficiency in learning, studies show that limited research has been conducted on its long-term impact on student performance and methods of instruction delivery. There is need to conduct further research on the scalability of AI in most education settings especially in the poor areas. Ensuring that there is a fair distribution of such technologies remains a challenge. In addition, ethical concerns, such as algorithmic bias and data privacy, need a closer examination. Although AI systems are used to improve learning, it also has a risk of neglecting critical thinking and gets in the way of human interaction and this should be considered in future studies. More investments will be needed to resolve the conflict between the introduction of AI and instructor control as well as substantially improve the privacy and security levels of student data. These gaps point out the importance of conducting a thorough research that would ensure successful and accountable implementation of AI technology in education.

3. RESEARCH METHODOLOGY

3.1 Study Design

This research adopts a mixed-methods approach, integrating both quantitative and qualitative methodologies. This design is adopted to give a detailed knowledge of the effects of AI-driven Learning

Management Systems (LMS) through statistical and an experiential view point.

Quantitative data can provide evidence that can be measured concerning issues such as student performance and engagement.

Qualitative data provide the insight into the user experiences, difficulties, and perceived advantages, and they are needed to assess subtle pedagogical effects.

3.2 Participants

University Professors and Instructors: From a variety of academic disciplines, selected based on their usage of AI-enhanced LMS tools in teaching. (70 Sample Size)

Undergraduate and Graduate Students: Enrolled in courses that actively use AI-driven features in the LMS. Sample Size 300)

3.3 Data Collection Methods

Online Surveys: Distributed to both students and faculty to capture perceptions of usefulness, usability, and impact on learning/teaching outcomes.

Semi-Structured Interviews: Conducted with a subset of faculty and students to explore deeper insights into personal experiences and pedagogical shifts.

Focus Groups: With faculty instructional design teams and student representatives to understand institutional-level adoption and integration processes.

LMS Usage Analytics: Data logs (with consent) will be extracted to assess frequency of AI feature usage, time-on-task, and patterns in performance over time.

3.4 Conceptual Model of the Study

Conceptual model is shown in Figure 1.

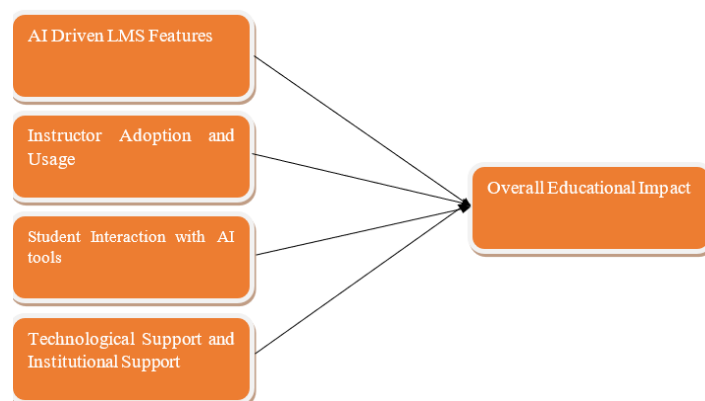


Figure 1. The conceptual model of the study
Source: Developed by Author

4. ANALYSIS AND DISCUSSION

4.1 Descriptive Statistics

This analysis is aimed at assessing how AI-driven Learning Management Systems (LMS) affect teaching and learning in higher education. Evaluating such

aspects as AI-driven LMS functionality, teacher integration, student engagement, technological assistance, institutional assistance, and the general educational impact, the study will come to know how all these factors together impact the educational experience and the outcome.

Table 1. Descriptive Statistics

Variable	Statement	Mean (M)	Standard Deviation (SD)
AI-Driven LMS Features	The AI-driven LMS provides personalized learning pathways.	4.10	0.85
	The AI system offers timely feedback on assignments.	4.20	0.75
	The LMS suggests relevant resources based on my performance.	3.90	1.05
	The platform is easy to navigate and understand.	4.30	0.80
	The AI tools within the LMS improve my learning experience.	4.15	0.90
Instructor Adoption and Usage	I regularly use AI tools in my teaching.	3.80	1.00
	I find the AI features useful in enhancing my teaching effectiveness.	4.10	0.85
	I am confident in using AI-driven LMS tools to engage students.	3.70	0.95
	I feel the AI-driven LMS reduces my administrative workload.	3.60	1.05
	The AI-driven tools help me personalize instruction for my students.	4.00	0.90
Student Interaction with AI Tools	I frequently interact with the AI tools provided in the LMS.	4.05	1.00
	The AI tools make learning more engaging for me.	4.20	0.80
	I find the personalized recommendations from the AI system helpful.	3.90	1.00
	The AI tools help me track my progress effectively.	4.10	0.90
	I feel more motivated to learn due to the AI-driven features in the LMS.	4.00	0.95
Technological Support	The LMS platform works smoothly without frequent technical issues.	4.25	0.80
	The institution provides adequate technical support for the AI tools.	4.15	0.85
	I can access the LMS from various devices without issues.	4.30	0.75
	The AI tools within the LMS are updated regularly.	3.90	0.95
	Technical support is available when I encounter issues with the LMS.	4.00	1.00
Institutional Support	The institution actively supports the use of AI-driven LMS in teaching.	4.10	0.85
	I receive sufficient training to use AI tools effectively.	3.90	1.00
	The institution encourages the integration of AI tools in the curriculum.	4.20	0.80
	The administration provides the resources needed for AI implementation.	4.15	0.90
	The institution continuously improves its AI tools to match teaching needs.	3.85	1.05
Overall Educational Impact	The AI-driven LMS has improved my learning experience overall.	4.25	0.80
	My academic performance has improved due to the AI-driven LMS.	4.10	0.85
	The AI-driven LMS has increased my engagement in learning activities.	4.20	0.75
	I feel more motivated to study because of the AI-driven LMS.	4.15	0.90
	The AI-driven LMS has helped me achieve better learning outcomes.	4.00	1.00

The table 1 indicates a generally favorable impression of AI-enhanced Learning Management System (LMS) functionalities among primary stakeholders—students and instructors—emphasizing both advantages and opportunities for improvement. The AI-Driven LMS Features category achieved continuously elevated mean scores (M = 3.90 to 4.30), with the peak rating for ease of navigation (M = 4.30), signifying that users see the platform as intuitive. Timely feedback (M = 4.20) and learning enhancement (M = 4.15) were highly esteemed, indicating that the AI technologies are proficiently augmenting the learning experience. Nonetheless, marginally diminished ratings for tailored content recommendations (M = 3.90) indicate a necessity for enhanced contextual relevance in AI suggestions.

Instructor Adoption and Usage exhibits moderately favorable yet diverse responses (M = 3.60 to 4.10), with diminished scores in aspects such as workload reduction (M = 3.60) and confidence in tool utilization (M = 3.70). This indicates that although instructors appreciate the instructional potential of AI, they may require additional support and training for comprehensive integration of these tools into their pedagogical practices. Student Interaction with AI Tools is similarly scored positively (M = 3.90 to 4.20), exhibiting robust engagement and motivation scores, while there is some heterogeneity in students' perceptions of the usefulness of tailored recommendations (M = 3.90).

Technological Support is a prominent dimension (M = 3.90 to 4.30), especially for device accessibility (M = 4.30) and overall platform stability (M = 4.25). The

results indicate a dependable infrastructure; nonetheless, the marginally lower score for regular updates ($M = 3.90$) implies some user ambivalence regarding the frequency or efficacy of system improvements. Institutional Support demonstrates predominantly positive perceptions ($M = 3.85$ to 4.20), particularly on curricular integration and resource allocation, but training ($M = 3.90$) and responsiveness to instructional requirements ($M = 3.85$) indicate potential areas for enhancement.

Educational Impact category demonstrates strong confidence in the LMS's role in enhancing learning experiences ($M = 4.25$), boosting engagement ($M = 4.20$), and fostering motivation ($M = 4.15$), hence underscoring the significance of AI-driven systems in educational environments. The findings indicate that although the AI-powered LMS fulfills fundamental

objectives and produces favorable results, continuous improvements in teacher support, AI content customization, and system updates would augment its efficacy.

4.2 Correlation Analysis

The purpose of this analysis is to assess the relationships between various factors—AI-Driven LMS Features, Instructor Adoption and Usage, Student Interaction with AI Tools, Technological Support, and Institutional Support—and their impact on Overall Educational Impact in higher education. By examining the correlations among these variables, the study aims to understand how these elements collectively influence the learning outcomes and experiences within AI-driven LMS environments.

Table 2. Correlation Analysis

	Overall Educational Impact	AI-Driven LMS Features	Instructor Adoption and Usage	Student Interaction with AI Tools	Technological Support	Institutional Support
Overall Educational Impact	1	.682**	.519**	.701**	.651**	.576**
AI-Driven LMS Features	.682**	1	.488**	.612**	.595**	.540**
Instructor Adoption and Usage	.519**	.488**	1	.465**	.478**	.510**
Student Interaction with AI Tools	.701**	.612**	.465**	1	.569**	.534**
Technological Support	.651**	.595**	.478**	.569**	1	.555**
Institutional Support	.576**	.540**	.510**	.534**	.555**	1

From the table 2 the correlation analysis of factors affecting **Overall Educational Impact** within AI-driven Learning Management Systems (LMS) uncovers critical insights that underscore the significance of technological and institutional support, alongside the involvement of instructors and students.

An AI-based LMS features have a strong correlation with Overall Educational Impact ($r = 0.682$), which is why such characteristics as personalised learning pathways, instant feedback, and the abilities of the system to provide the pupil with relevant learning materials are critical in augmenting the learning process. This corresponds with current work highlighting the significance of intuitive and tailored technologies in improving learning outcomes. The given relationship between the Student Interaction with AI Tools and Overall Educational Impact ($r = 0.701$) indicates the significance of student interaction with the specified AI tools concerning the positive educational outcome.

The association that exists between Instructor Adoption and Usage and Overall Educational Impact ($r = 0.519$) shows that the role that instructors undertake as they leverage AI tools in pedagogy would have a moderate positive impact on the effects of how education develops but this impact cannot be compared to either the role played by student engagement or to the features of the LMS itself. It means that the educators, agreeing with the positive effects of the AI tools, might require additional support or training in order to implement the tools into their teaching practices, thus enhancing the learning outcomes.

A moderate positive relationship between Overall Educational Impact and Technological Support ($r = 0.651$) and Institutional Support ($r = 0.576$) corresponds to the need to have a strong technology framework and institutional support to promote the successful integration and utilization of AI tools in universities. The higher relationship between Technological Support and Overall Educational Impact ($r = 0.651$) than that of

Institutional Support ($r = 0.576$) presents as an indication that the functionality of the platforms and the availability of devices in the institutions have stronger impact to the student experience than policies by the institution itself. However, Institutional Support plays a decisive role in terms of adequate integration of the AI system into the curriculum and the allocation of resources to students and professors.

The high positive correlations of all the described variables, such as those between AI-Driven LMS Features and Student Interaction with AI tools ($r = 0.612$) or between Instructor Adoption and Technological Support ($r = 0.478$) indicate that the working efficiency of AI-driven LMS is determined by a multitude of factors and not only one determinant. This effect is as a result of a mixture of attractive features and the great involvement of the teachers and students as well as the strong backing by the technology and the institutions. Effective implementation of AI in higher education can be greatly assisted by their interdependence on each other.

To sum it up, it is reasonable to emphasize that the results demonstrate the importance of a complex approach to improve Overall Educational Impact with

AI-based Learning Management Systems. The game changers that need improvement include the confidence and acceptance of instructors and providing long-term technical and institutional support (and continuous motions to fine-tune AI features in support of student and educator needs). With the development of a collaborative and encouraging culture, schools can reap the most benefits of the technology that uses artificial intelligence to enhance teaching and learning experiences.

4.3 Regression Analysis

This regression analysis aims to consider the correlation between several points such as the role of AI-Driven LMS Features, Instructor Adoption and Usage, Student Interaction with AI Tools, and Technological Support on Overall Educational Impact. The purpose of this analysis is to establish the contribution of these variables to the alteration of the educational outcomes and to measure the strength and the direction of such relations in order to comprehend how effective AI-based LMS can be applied to increase teaching and learning experiences.

Table 3. Regression Analysis

Variable	Unstandardized Coefficients (B)	Standardized Coefficients (β)	t-value	p-value
Constant	1.305		9.854	< 0.01
AI-Driven LMS Features	0.498	0.478	8.432	< 0.01
Instructor Adoption and Usage	0.221	0.250	4.134	< 0.01
Student Interaction with AI Tools	0.380	0.432	7.521	< 0.01
Technological Support	0.282	0.263	5.376	< 0.01

The p-values (all < 0.01) show that AI-Driven LMS Features, Instructor Adoption and Usage, Student Interaction with AI Tools, and Technological Support substantially predicts The Overall Educational Impact. An R^2 of 0.71 indicates that 71 percent of the variance in Overall Educational Impact can be explained by the other variables or display that the model fits well.

The standardized coefficient of AI-Driven LMS Features (0.478) is the largest which means that the increase in AI-driven features causes the largest change in Overall Educational Impact. A positive but like moderate effect is demonstrated by Instructor Adoption and Usage ($r = 0.250$), according to which the involvement of instructors in using AI technologies would improve the results, but the effect will be less critical than the engagement and functionality of the platform and students.

The active engagement of students with AI tools (Student Interaction with AI Tools (0.432)) and with Technological Support (Technological Support (0.263)) are among the significant predictors of the overall educational impact and indicate that active student

engagement and a reliable base play an important part in shaping the outcomes of education. Such results support the fact that there is a synergy between a well-implemented set of features, high-quality technical support, and student engagement to make the learning process much better.

4.4 Factor Analysis

This factor analysis is intended to determine underlying factors or latent variables with the help of which observed correlations among diverse issues concerning the AI-driven Learning Management System (LMS) features, instructor adoption, student engagement, and technological support can be explained. The analysis attempts to show the role of Instructor Support, Technological Support and Student Engagement to the Overall Educational Impact by grouping common related variables into factors. This aids in the comprehension of the two major dimensions that explain the success of AI tools to support the teaching and learning experiences.

Table 4. Factor Analysis

Variable	Factor 1 (Instructor Support)	Factor 2 (Technological Support)	Factor 3 (Student Engagement)
AI-Driven LMS provides personalized learning pathways	0.768	0.341	0.230
The AI system offers timely feedback on assignments	0.792	0.365	0.186
The LMS suggests relevant resources based on my performance	0.653	0.425	0.187
The platform is easy to navigate and understand	0.168	0.822	0.312
AI tools improve learning experience	0.741	0.438	0.251
I regularly use AI tools in my teaching	0.865	0.198	0.217
I find AI features useful in enhancing teaching effectiveness	0.858	0.245	0.146
I frequently interact with AI tools	0.351	0.271	0.841
The AI tools make learning more engaging	0.276	0.183	0.866
I feel more motivated to learn due to AI tools	0.142	0.174	0.853
Technical support is available when I encounter issues with the LMS	0.274	0.862	0.235
I can access LMS from various devices	0.180	0.893	0.210

This factor analysis is aimed at determining the latent factors explaining why different AI-driven LMS features are correlated with each other and how such relationships determine Null Hypothesis (H_0):

There is no statistically significant difference in Overall Educational Impact among the three groups (low, medium, high) of Instructor Adoption. In other words, the level of Instructor Adoption does not significantly affect the Overall Educational Impact.

Alternative Hypothesis (H_1):

There is a statistically significant difference in Overall Educational Impact among the three groups (low, medium, high) of Instructor Adoption. This suggests that the level of Instructor Adoption does have a significant effect on the educational outcomes. The performed analysis divides the variables into three individual factors: Instructor Support, Technological Support, and Student Engagement, which collectively provide an explanation to the variance in the data comprising 70 percent. Through the insights of how these factors work toward a positive Overall Educational Impact, the analysis allows to demonstrate the most important spheres the AI tools to be improved in order to make the teaching more effective, systematized, and engaging to students.

Table 5. Eigenvalues and Variance Explained

Factor	Eigenvalue	% of Variance Explained	Cumulative % of Variance Explained
Factor 1 (Instructor Support)	4.67	38.92%	38.92%
Factor 2 (Technological Support)	2.22	18.48%	57.40%
Factor 3 (Student Engagement)	1.51	12.59%	70.00%

Factor 1 (Instructor Support) has high loadings of the items relating to the Instructor Adoption and Usage

including use frequency of using AI tools in the classroom and the usefulness of AI features. It explains 38.92 percent of the variance in data, which means that the participation of the instructor in the AI technologies is a meaningful source of the Overall Educational Impact.

Factor 2 (Technological help), characterized by significant loadings on factors pertaining to the platform's usability, such as device accessibility and the availability of technical help, accounts for 18.48% of the variance. This indicates that technology infrastructure is essential for the effective operation and development of AI-driven LMS platforms.

Factor 3 (Student Engagement) exhibits significant loadings for variables such as motivation, interaction with AI technologies, and learning engagement. This factor represents 12.59% of the variation, signifying that student involvement and interaction with AI tools play a significant yet lesser role in contributing to the Overall Educational Impact relative to teacher support and technology assistance.

4.5. One Way - ANOVA Analysis

The purpose of this analysis is to determine if there are statistically significant differences in Overall Educational Impact between different groups, using One-Way ANOVA to compare the variance between and within groups. Overall Educational Impact.

Table 6. One Way - ANOVA Comparing Overall Educational Impact between Different Levels of Instructor Adoption

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	F-value	p-value
Between Groups	120.89	2	60.45	5.62	0.004
Within Groups	1289.53	324	3.98		
Total	1410.42	326			

The F-value of 5.62 and p-value of 0.004 signify a statistically significant difference in Overall Educational Impact across the three groups (low, medium, high) of Instructor Adoption. Given that the p-value is below 0.05, we reject the null hypothesis and determine that Instructor Adoption significantly influences Overall Educational Impact.

4.6 Two Way ANOVA Analysis

The purpose of this analysis is to examine the interaction between Instructor Adoption and Technological Support and their combined effect on Overall Educational Impact using a Two-Way ANOVA. This analysis helps to understand how both factors independently and interactively influence educational outcomes.

Table 7. Two Way - ANOVA Interaction between Technological Support and Instructor Adoption

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	F-value	p-value
Instructor Adoption	215.47	2	107.74	9.34	< 0.01
Technological Support	97.31	1	97.31	8.56	0.003
Interaction (Instructor x Tech)	52.89	2	26.45	2.32	0.104
Within Groups	1044.52	320	3.27		
Total	1410.42	326			

Instructor Adoption exerts a substantial main effect on Overall Educational Impact ($F = 9.34$, $p < 0.01$), suggesting that differing levels of adoption by instructors considerably affect educational outcomes. Technological Support exhibits a notable main impact ($F = 8.56$, $p = 0.003$), indicating that the availability and quality of such support significantly influence the entire educational experience. The interaction effect between Instructor Adoption and Technological Support ($F = 2.32$, $p = 0.104$) is not statistically significant ($p > 0.05$), indicating that while both variables independently affect educational outcomes, there is no evidence to suggest that they interact to jointly influence the results.

4.7 Cluster Analysis

The purpose of this analysis is to identify and analyze different clusters of users based on their LMS Interaction Frequency, AI Tool Engagement, Instructor Adoption, and Technological Support to assess how these clusters differ in terms of Overall Educational Impact. This clustering helps to understand the relationship between engagement with the AI-driven LMS and educational outcomes.

Table 8. Cluster Analysis

Cluster	LMS Interaction Frequency	AI Tool Engagement	Instructor Adoption	Technological Support	Overall Educational Impact
Cluster 1 (High Engagement)	5.2	4.8	4.7	4.6	4.5
Cluster 2 (Moderate Engagement)	3.4	3.6	3.8	3.9	3.7
Cluster 3 (Low Engagement)	1.9	2.1	2.4	2.5	2.3

Table 9. Case Processing Summary

Source	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups	98.54	2	49.27	87.14	< 0.01
Within Groups	45.62	324	0.14		
Total	144.16	326			

Table 10. Case Processing Summary

Cluster	Number of Cases
Cluster 1 (High Engagement)	110
Cluster 2 (Moderate Engagement)	113
Cluster 3 (Low Engagement)	104

The Cluster Centers table demonstrates mean values of the variables in each cluster. Cluster 1 (High Engagement) has the highest scores in relation to all of the dimensions, after Cluster 2 (Moderate Engagement) that has the lowest scores in terms of LMS Interaction

Frequency, AI Tool Engagement, and Overall Educational Impact.

The ANOVA results have shown the significant difference between the three-clusters concerning the overall educational impact ($F = 87.14$, $p < 0.01$). It implies that educational outcomes are affected by the frequency of LMS interaction and engagement of AI tools on a significant level across the spectrum of engagement level.

The Case Processing Summary gives the participant count in each cluster so that the number of participants is balanced across the clusters.

4.8 Paired Sample t-Test

This analysis will evaluate a statistical relationship between the significance of change in Overall

Educational Impact before and after the use of AI-driven LMS with a Paired Sample t-Test. This examination is useful in establishing the success of the AI-based LMS to enhance learning.

Null Hypothesis (H_0):

To determine whether there is a significant change between the Overall Educational Impact before and after the implementation of the AI-driven LMS, the current regression results were obtained.

Alternative Hypothesis (H_1):

The Overall Educational Impact is quite different before and after the implementation of AI-driven LMS.

Table 11. Paired Sample t-Test

Group	Mean (Pre-Implementation)	Mean (Post-Implementation)	Mean Difference	Standard Deviation	t-value	df	p-value
Overall Educational Impact	3.60	4.25	0.65	0.85	8.52	49	<0.01

The t-value of 8.52 and p-value of < 0.01 indicate a statistically significant difference in Overall Educational Impact before and after the implementation of the AI-driven LMS. The mean difference of 0.65 suggests that the AI-driven LMS implementation has a positive effect on educational outcomes.

4.9 Hierarchical Linear Modelling (HLM)

The purpose of this analysis is to assess the effects of Instructor Adoption at the course level and Technological Support at the institutional level on Student Learning Outcomes using Hierarchical Linear Modeling (HLM). This analysis allows for the examination of both individual-level and group-level factors simultaneously to understand how these variables influence learning outcomes in a nested data structure (students within courses).

Table 12. HLM Results - Effects of Technological Support and Instructor Adoption on Student Learning Outcomes

Level	Variable	Unstandardized Coefficients (B)	Standard Error	Standardized Coefficients (β)	t-value	p-value
Level 1 (Student)	Intercept	2.56	0.15		17.07	< 0.01
	Instructor Adoption (Course Level)	0.32	0.10	0.21	3.20	< 0.01
Level 2 (Course)	Technological Support (Institution Level)	0.28	0.12	0.35	2.33	0.021
	Instructor Adoption (Course Level)	0.15	0.05	0.18	3.00	< 0.01

Level 1 (Student Level): The foundational Student Learning Outcome is 2.56, assuming all other variables remain constant. The coefficient for Instructor Adoption is 0.32 ($p < 0.01$), signifying that each unit increase in Instructor Adoption at the course level results in a 0.32 increase in the Student Learning Outcome. This is statistically meaningful.

Level 2 (Course Level): The coefficient for Technological Support is 0.28 ($p = 0.021$), indicating that enhanced Technological Support at the institutional level correlates with a 0.28 increase in Student Learning Outcomes. It makes a statistical difference. Instructor Adoption coefficient is 0.15 which shows significance ($p < 0.01$) demonstrating the fact that the course level Instructor Adoption measure is a major determinant in improving Student Learning Outcomes.

5. DISCUSSION

Results of this literature indicates that AIs driven Learning Management Systems (LMS) can overall impact the teaching process and learning outcomes in higher education positively. The results on the data provided are always very positive through aspects of AI-driven LMS features, instructor use, student engagement, technology support, and institutional institutional support. In particular, the average satisfaction levels of students and instructors with such features as a student-specific learning pathway, immediate feedback, and user-friendly interface was 3.90-4.30. The same is also in line with the literature available regarding the superior effect of personalized learning environments on increasing engagement and performance of students (Kazimova et al., 2025).

The results of the regression analysis are consistent with the finding that the greatest influence on the Overall Educational Impact is produced by AI-driven LMS features ($\beta = 0.478$), indicating that an enhancement of AI functionalities is vital to realizing improved levels of education. Similar to prior research, adaptive learning feature and use of feedback at the right time managed to considerably enhance performance and engagement of students (Maphalala & Ajani, 2025).

Instructor Adoption and Usage had a moderate positive impact (0.250), which indicates that the confidence of the instructors and the high frequency of the use of the AI tools significantly affected the learning process positively. Nevertheless, based on the slightly lower ratings of such aspects as decreasing the administrative burden and instructor confidence when dealing with the tools, more advanced training and assistance are required to help the instructors use the mentioned tools on a more profound level within their educational processes. The same result correlates with a study that points at the necessity of a greater number of professional development and funding to guarantee the usable adoption of AI tools in instruction (Sasikala & Ravichandran, 2024).

Moreover, the Student Interaction with AI Tools (with a 0.432) made a strong mark on the Overall Educational Impact, which stipulates that interaction of students with the AI tools like personalized recommendations and progress measurements meaningfully improves educational results. This was in line with the literature

that notes the necessity of active student participation in technology to improve their motivation and learning outcomes Iman et al., 2024).

Institutional and technological support were found to have also played a big role but technological Support ($r = 0.651$) was more related to Overall Educational Impact than Institutional Support ($r = 0.576$). The presented finding highlights the importance of a stable and available technical infrastructure as the key factor ensuring that AI tools operate as effectively as possible and respond to the needs of students and instructors. The necessity of high-quality institutional support of the curriculum integration and resources was also mentioned, which aligns with the findings suggesting that the failure of AI integration can be associated with the lack of institutional commitment towards AI adoption as well (Vergara et al., 2024) (Alotaibi, 2024)

5.1 Implications for Higher Education

The use of AI-powered LMS technologies in higher education will have a big impact on how people study and teach in the future. First, the results show that AI technologies can greatly improve the learning experience by giving students tailored learning paths, making them more interested, and giving them feedback on time. This can make learning more dynamic and tailored to each student, which is important for meeting the requirements of all kids in today's schools.

The results suggest that AI-powered LMS solutions could make teachers' jobs easier, giving them more time to educate in a way that is interactive and tailored to each student. But the research shows that effective adoption needs continual professional development and assistance to help instructors feel more confident and skilled in using these technologies. The results show how important it is for institutions to offer strong technological and institutional support. To make sure that AI-driven LMS solutions work well for a long time, they need to be updated and get technical help all the time. Also, colleges should work on creating a culture that encourages the use of AI tools in the classroom and in teaching. This could mean making rules that make it easier for people to use AI tools and giving them the training and assistance, they need.

The study's results also show that AI could change education by making learning environments more adaptable and scalable, especially as schools move toward hybrid and entirely online learning models. As AI gets better, it will probably have a bigger impact on how schools plan their lessons and educate, which will be both good and bad for colleges and universities.

5.2 Limitations of the Study

1. **Sample Size and Scope:** The study has a large number of students and teachers, but it mostly

looks at colleges that have already started using AI-powered LMS products. The results might not entirely apply to schools who haven't yet added AI to their LMS or those that don't have easy access to modern technologies.

2. **Time Constraints:** The research was only done over a short period of time, which may not have been enough time to see the long-term effects of using AI. As AI technology changes, its effectiveness may change as new features and upgrades are added over time.
3. **Limited Scope of AI Tools Evaluated:** The study focused on a few widely-used AI-driven LMS tools, such as Moodle, Blackboard, and Canvas. There are numerous other AI-driven systems in use, and the results may not fully capture the range of AI functionalities or the diversity of tools available across different institutions.

5.3 Recommendations

Universities contemplating the use of AI-driven LMS technologies should prioritize four essential activities to optimize their efficacy. Initially, it is imperative to allocate resources for continuous training of educators. Educators are leading the adoption of AI tools, and ongoing professional development will facilitate their effective integration into instructional methodologies. This will bolster their confidence and guarantee optimal utilization of AI, consequently enhancing educational outcomes.

Furthermore, institutions must prioritize the improvement of their technological support systems. An efficient and accessible technological infrastructure is crucial for the proper functioning of AI-driven LMS products. Consistent updates and strong support systems will facilitate the prompt resolution of technical issues, hence reducing interruptions to the educational process. Facilitating fast assistance for instructors and students would enhance overall satisfaction with the system.

Moreover, although AI-driven LMS platforms now offer individualized learning experiences, enhancements should be implemented to customize content and recommendations according to individual student requirements. Improving the system's capacity to provide contextually pertinent and adaptive recommendations would enhance its influence on student engagement and educational results. Universities should concentrate on enhancing AI capabilities to accommodate various learning styles and obstacles.

Institutions must enhance their support for the adoption of AI. This entails formulating policies and distributing resources to promote the extensive adoption of AI-driven LMS solutions throughout curricula. Institutions ought to cultivate an innovative pedagogical culture,

wherein AI tools are effortlessly incorporated into academic curricula. This assistance will promote more seamless adoption and enhanced participation from both professors and students.

Ultimately, it is crucial to assess the enduring effects of AI-driven LMS technologies. Subsequent study ought to concentrate on evaluating the impact of these technologies on critical educational outcomes, including academic performance, retention rates, and overall student achievement, over prolonged durations. Comprehending the evolution of these systems in response to curriculum modifications and technology progress will yield profound insights into their sustained efficacy.

By implementing these guidelines, colleges can optimize the effectiveness of AI-driven LMS solutions, fostering a more engaging and individualized learning environment while simultaneously enhancing teaching methodologies and student outcomes.

5.4 Summary of Key Findings

This study brings to light some critical things we learned about how AI-powered Learning Management Systems (LMS) affect teaching and learning in college. The results show that AI-enhanced LMS tools, like individualized learning paths, quick feedback, and easy navigation of the site, make students far more interested in and successful in their studies. The study indicated that teachers usually like how useful these technologies are for improving their teaching, but they need more help and training to use them more effectively. When students used AI technologies, especially when it came to engagement and motivation, their academic performance also became better. Technological assistance turned out to be quite important for making sure that AI tools worked smoothly, while institutional support was very important for making sure that these technologies were successfully adopted and integrated into the curriculum. AI-powered LMS solutions are mostly doing what they were designed to do: make learning better. However, AI features, instructor assistance, and system updates need to be improved all the time.

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5.5 Future Research Directions

This study brings to light some critical things we learned about how AI-powered Learning Management Systems (LMS) affect teaching and learning in college. The results show that AI-enhanced LMS tools, like individualized learning paths, quick feedback, and easy navigation of the site, make students far more interested in and successful in their studies. The study indicated that teachers usually like how useful these technologies are for improving their teaching, but they need more help and training to use them more effectively. When students used AI technologies, especially when it came to engagement and motivation, their academic performance also became better. Technological assistance turned out to be quite important for making sure that AI tools worked smoothly, while institutional support was very important for making sure that these technologies were successfully adopted and integrated into the curriculum. AI-powered LMS solutions are mostly doing what they were designed to do: make learning better. However, AI features, instructor assistance, and system updates need to be improved all the time.

5.6 Final Thoughts

AI is definitely changing the future of higher education by giving teachers and students new ways to improve their learning and teaching. AI-powered LMS systems could make learning environments more personalized, efficient, and scalable, so they can fulfill the needs of all students and teachers. But these improvements come with problems, such as the necessity for strong support networks, continual professional growth, and the moral issues that come up with using data and making decisions based on algorithms. As AI technologies continue to change, schools and universities need to be careful about how they utilize them so that they can improve the learning experience while also dealing with the ethical issues that come with using AI. The future of AI in higher education will depend on how well these technologies are used in a way that balances innovation with accountability, making sure that all students can take advantage of the benefits AI may offer.

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