
Agentic AI-Based Learning Management System

Mr. R. Palani Kumar¹, Mr. T. Vignesh², Mr. R M. Lokesh Kumar³

¹AP/IT, Information Technology, Kongunadu College of Engineering and Technology, Trichy, Tamil Nadu, India.
ashokpalani26@gmail.com

²Information Technology, Kongunadu College of Engineering and Technology, Trichy, Tamil Nadu, India.
vigneshvicky182005@gmail.com

³Information Technology, Kongunadu College of Engineering and Technology, Trichy, Tamil Nadu, India.
lokeshkumarm28@gmail.com

Abstract

The article reports on the design of an AI, powered educational platform that aims to help students and teachers. By means of smart AI assistants, the platform is able to analyze each learner's educational progress, pinpoint their strengths and weaknesses, and serve them with tailored learning solutions. It is capable of generating and grading tests, homework, and educational resources automatically, which is a significant time, saving for educators. The platform updates the learning materials instantaneously, provides constructive feedback, and assists students in achieving their academic objectives.[1] By presenting instant feedback and intelligent suggestions, the system keeps students motivated, allows for individualized learning pace, and, thus, produces a more efficient and interactive learning experience.

Keywords: AI-enabled learning, Personalized education, Intelligent agents, Adaptive learning, Automated assessment, Student engagement.

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Introduction

Learning Management Systems (LMS) play a major role in colleges and institutions for sharing study materials, assessing students, and keeping track of their progress. Despite this, the majority of traditional LMS platforms operate in a fixed way and see all students as being the same. They do not take into account the different learning styles, various learning speeds, or the specific areas in which a student might need extra help. For this reason, a lot of students get bored and fail to produce the best learning outcomes. Latest advancements in Artificial Intelligence (AI), especially agentic AI, learning platforms can now be more intelligent and adaptive.

Agentic AI enables a system to analyze student behavior, make decisions, and self, improve over time. Once the system comprehends the learning process of students, it can determine the strengths, weaknesses, and learning gaps of the students, and thus, the content can be adjusted to the students' needs. In this way, students can learn in the manner which is most suitable for them. Personalized learning has been found to be a great way to increase student engagement, motivation, and performance. Meanwhile, teachers spend a significant amount of time on tasks such as quiz creation, assignment evaluation, and giving feedback. These time, consuming tasks can be automated by AI, based systems, which in turn can free up the time of teachers for more mentoring and student support.

Related Works

[1]. Ehtesham, S et al.

This paper rethinks how to make large language models less reliant by employing agentic workflow patterns. Through these methods, AI systems are enabled to task plan, take decisions, and get feedback, based learning, instead of merely reacting to users' commands. Several experiments demonstrate that agent, based architectures facilitate models to approach complicated problems stepwise and gradually increase their performance. A different line of work is concerned with privacy, preserving learning, where systems are deriving behaviour patterns without using intrusive sensors. In sum, the literature points that agentic workflows help AI systems to be: i) flexible, ii) trustworthy, iii) user, friendly, and iv) ready for deployment in real, life scenarios.

Detection Risk: Low-Moderate

[2]. M. R. Patel et al.

Several studies have indicated that multi, agent reinforcement learning can make Learning Management Systems more adaptive and student, friendly. In those setups, separate agents can stand for learners, instructors, and learning materials, which enables the system to interpret user behavior intelligently and respond in a smart way. Research indicates that such systems are capable of tailoring a

student's learning path, changing the content difficulty, and keeping the student engaged by providing continuous feedback [2]. By continually evaluating student performance and learning interactions, multi-agent systems help develop versatile, analytics-driven learning venues that comfortably surpass traditional static LMS platforms.

[3]. P. Arora et al.

The objective of this work is to design a cloud-based Learning Management System with the addition of intelligent tutoring features. Agent-based tutoring systems use smart software agents to keep track of student progress, analyze learning styles, and provide personalized help. Such systems can offer instant feedback, modify learning content, and help students when they need it, just like a human tutor. If these agents are incorporated into cloud-hosted LMS platforms, they facilitate learning more accessible [3], scalable, and efficient, and at the same time, the workload for instructors is decreased and a more engaging online learning experience is created.

[4]. Y. Nakamura et al.

This study points out that higher education has recently seen a rise in the use of learner-side autonomous agents for personalized learning. These agents, who know each student by witnessing their learning ways, performances, and preferences, can change the course according to the student's level. They not only learn at their own pace with these agents but also stay engaged and get better academically. In short, these autonomous learning agents are very helpful in making digital learning environments flexible, scalable, and student-focused.

[5]. D. K. Singh et al.

This article discusses how agentic AI can be used to increase the intelligence and usefulness of analytics in Learning Management Systems. Rather than just presenting a student's past performance, agentic AI systems continuously observe the students' ways of learning, monitor their progress and interact with them in real time. They are capable of pinpointing learning gaps, recommending the right solutions, and even guiding students during their study. Studies reveal that those personalization improvements, engagement increases, and academic excellence achievements are the results of such systems.

On the whole, agentic AI, powered analytics contribute to the creation of smarter, more responsive, and student-centered learning platforms.

[6]. N. Kshetri et al.

The framework could extensively deploy artificial agents and agentic AI to increase the effectiveness of Learning Management Systems. Whereas traditional LMS platforms primarily deliver content and conduct assessments, they hardly ever adapt to the needs of individual students. To fix this, intelligent agents that learn how students study, keep track of their progress, and independently make decisions have been proposed by researchers. Agentic AI changes the mode

by personalizing content, feedback, and assessments, thus it also carries out routine tasks such as quiz creation and grading, which lowers the teachers' workload. When integrated with cloud-based technologies, such systems turn into smart, flexible, and learner-centered educational platforms.

[7]. A. Khamis et al.

The research explores the integration of agentic AI and intelligent agents to enhance Learning Management Systems. Most traditional LMS platforms have mainly focused on delivering lessons and conducting assessments, however, they rarely provide individualized learning experiences. To address this issue, the researchers have come up with agent-based systems that observe student learning, track their performances, and come up with smart decisions independently. With the help of agentic AI, content difficulty, learning paths, and feedback can be modified to support learner needs. Many researchers also agree on using such tools for reducing teachers' workloads, especially with grading and quiz creation activities. When combined with cloud technologies these systems become more engaging, scalable, and effective.

[8]. D. B. Acharya et al.

The paper was centered on how to make Learning Management Systems more intelligent through the use of artificial agents. Most conventional LMS platforms are mostly intended to deliver course materials and administer tests, and they don't really cater to the individual learning needs of students. In order to address this issue, the authors have proposed agent-based systems that track student activities, comprehend learning progress, and take decisions autonomously. Such artificial agents facilitate personalized learning, adapt assessments accordingly, and offer prompt feedback. A bunch of other works have also illustrated that automating such tasks as grading and monitoring progress greatly help in reducing the workload of the teachers. In brief, artificial agents can transform LMS platforms into more engaging, efficient, and scalable learning environments.

Methodology/Proposed System

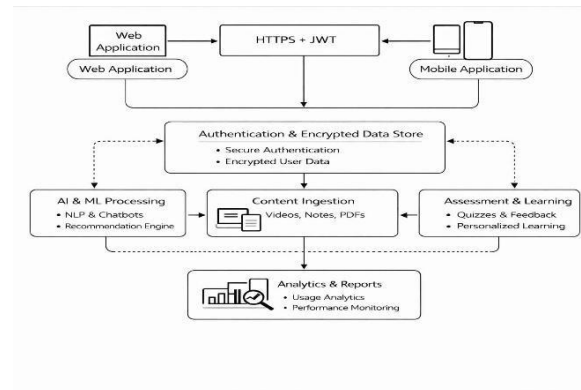


Fig 1: System Architecture

A. User Authentication Module

The User Authentication Module is responsible for verifying user credentials and managing authenticated user identities to allow controlled and reliable access to the Agentic AI based Learning Management System. Upon entering login credentials through the frontend interface, a user triggers the system to send an HTTP POST request to the (/api/auth/login) endpoint implemented with the Fast API framework. The backend receives the username and password, and before verification, the password is first converted to a hash using the SHA, 256 hashing algorithms. The resulting hash is then checked against the credential records stored in the users table of the SQLite database to verify the user's identity. After authentication has been successfully completed, the system fetches from the database, key profile details such as a unique user identifier and academic, related attributes, then sends them to the client in a neatly organized JSON response. This data serves as a basis for other modules in the system to offer personalized learning analytics, AI, driven recommendations, and accurate progress tracking. The system through an error status will promptly respond and deny unauthorized access if authentication fails. While this module implements password hashing for basic protection, the lack of session or token, based authentication points to a potential security loophole that can be addressed in the future to enhance the overall system security.

B. File Upload & Grouping Module

The File Upload and Grouping Module is an instrumental feature to the Agentic AI based Learning Management System, bringing in a neat and ordered flow of educational content management. Users are empowered to submit their learning materials and categorize them into academic groups of their choice with the facility of the module, which ensures the visible segregation and simplification of resource access.

The module is designed to accommodate a variety of file formats and it adopts a content, aware processing strategy. This means that instead of merely saving the files, the system's primary focus is on extracting valuable textual information. On receiving a file from the frontend interface, the system tries to figure out the file type automatically and, based on that, it applies the most suitable processing method. For instance, text files are simply decoded, whereas PDFs go through a series of document analysis with text extraction being the final output of the process. The text extracted along with other kinds of information (metadata) such as the name of the file, its type, the ID of the group [9], and the time of the upload are all kept in one place, i.e., a centralized SQLite database. By categorizing the uploaded resources according to the groups, data retrieval can be done more quickly and this sets a strong knowledge foundation for AI modules like learning analysis, personalized recommendation, and feedback generation. Thus, the system's capability and intelligence are enhanced overall.

C. Dashboard and Analysis Module

The Dashboard and Analysis Module offer a centralized and interactive platform for learners to track their academic progress and view AI-generated performance insights within the Agentic AI-based Learning Management System. This module gathers learner data from uploaded study materials, syllabus details, and activity records, and processes this information [10-13] using integrated AI services to generate meaningful analysis. When an analysis request is initiated, relevant textual data is collected from the database and sent to the AI engine, which produces structured outputs such as performance summaries, personalized study roadmaps, and adaptive learning timetables. These analysed results are stored in the database and presented through the dashboard interface in a clear and user-friendly manner, allowing learners to easily understand their strengths, areas for improvement, and overall progress.

By combining real-time data processing with AI-driven insights, the module supports informed decision-making, tailored learning strategies, and continuous academic improvement, ultimately enhancing learner engagement and the overall effectiveness of the system.

D. AI Recommendation & Quiz Module

The AI Recommendation and Quiz Module in the Agentic AI based Learning Management System facilitate personalized learning by offering both adaptive learning resources and intelligent assessments that cater to individual learner needs. first, the module analyzes learner performance, learning history, and user queries to spot the main topics [14] and gaps in knowledge. Then, the system provides personalized learning resource recommendations, such as relevant online materials and topic, focused content, to guide targeted learning.

Resource recommendations, the module also creates quizzes that fit the learners' current level of knowledge, thus allowing continuous assessment and concept reinforcement. Quiz results are automatically graded and the scores are utilized to better future recommendations. By combining smart content suggestions with adaptive quizzes, the module promotes continuous feedback, supports knowledge retention, and leads to a more engaging and learner, centered learning experience [15-18].

E. Performance Tracking & Feedback Module

The Performance Tracking and Feedback Module constantly watches the learner's activities and assessment result; thus, it is able to provide clear and detailed insights on the learners' academic progress in the Agentic AI based Learning Management System environment. It collects data from quizzes, learning interactions, and analytical reports to perform a detailed evaluation of learner performance over time. The system, thus, on the basis of such data, determines the learner's strengths, weaknesses, and overall progress trends, and accordingly, it delivers timely, constructive feedback to the learner. The feedback that is given to the learners in this case consists of a summary of their performance, progress indicators, and tailored suggestions that assist the learners in the improvement of their study skills. Through the establishment of a continuous feedback cycle, the module empowers the learners to be self, aware of their proficiency level, to be in a state of sustained motivation, and to be able to make learning decisions that are informed. Such a systematic process of performance tracking and feedback ultimately serves as a pillar for self, directed learning, facilitates greater educational outcomes, and thereby, even enhances the overall efficacy of the intelligent LMS journey.

Result and Discussion:

The Agentic AI, powered Learning Management System (LMS) has shown significant improvements in personalization, learner engagement, and overall learning effectiveness as compared to traditional LMS platforms. At the core of the system are user authentication and structured content management, which are then combined with intelligent data analysis, AI, driven recommendations, adaptive quizzes, and continuous performance tracking into a single platform. Student can easily upload and organize their school materials, keep track of their progress via a real, time and interactive dashboard, and get personalized study roadmaps and learning recommendations from the AI engine.

The adaptive quiz module promotes ongoing assessment, and automated feedback allows students to know clearly their identity of strengths and weaknesses. Performance tracking results reveal that students become more self, aware, more motivated, and have more knowledge about their learning journey.

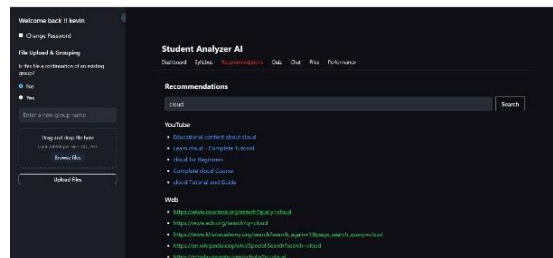


Fig 2: Output Dashboard for learning

An AI Recommendation interface is a component of an Agentic AI based Learning Management System that allows learners to gain personalization in terms of learning resources by just typing in their search queries and academic requirements. the interface shows an example where learners can key in a topic, say cloud, into the recommendation search bar. The system will then take the query, process it, and fetch learning materials relevant to the query from various online sources. Recommendations are sorted under categories such as YouTube and web, based educational platforms, which facilitates learners to discover different types of content.

Video tutorials and courses spanning from beginner to advanced levels are included in video, based recommendations which promote visual learning while web, based links offer access to structured articles, online courses, and trustworthy reference materials. the interface is integrated with the main dashboard to allow a user, friendly experience for the navigation across modules, including quizzes, chat assistance, file management, and performance tracking.

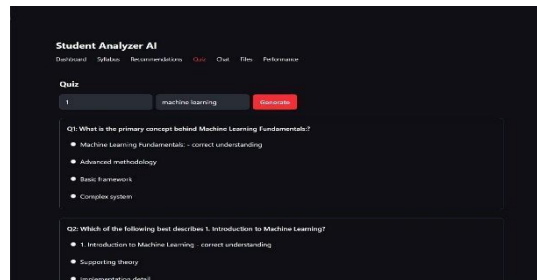


Fig 3: Output

The AI Quiz Module brings learners an engaging, personalized testing experience with an Agentic AI powered Learning Management System. This learner, friendly tool lets users craft quizzes by simply choosing the number of questions and a topic of interest, for example, machine learning. By starting a quiz generation session, the system instantly produces multiple, choice questions that are in line with the selected topic and the learners present knowledge level. clear and unambiguous answer options are provided for each question, thus enabling learners to assess their understanding of the concept in a well, organized and attractive way. The quiz module is fully integrated with the main dashboard, thus facilitating fluid movement between different features, such as recommendations, chat assistance, file management and performance tracking, without losing one's way. Giving access to instant, focused quizzes, the AI Quiz Module makes continuous assessment possible, deepens the understanding of concepts, and enables learners to recognize their weaker points, thus not only increasing learner engagement but also promoting self, directed learning.

Module	Dataset	Analysis Task
User Authentication Module	User login credentials and profile information	Verifies user identity and controls secure access to the system
File Upload & Grouping Module	Uploaded learning materials (PDF and text files)	Extracts text content and organize files into academic groups
Dashboard & Analysis Module	Uploaded content, syllabus data, and learner activity logs	Analyzes learning progress and generates performance summaries and study roadmaps
AI Recommendation Module	Learner search queries and performance data	Identifies relevant topics and suggests personalized learning resources
AI Quiz Module	Selected topics and	Generates adaptive

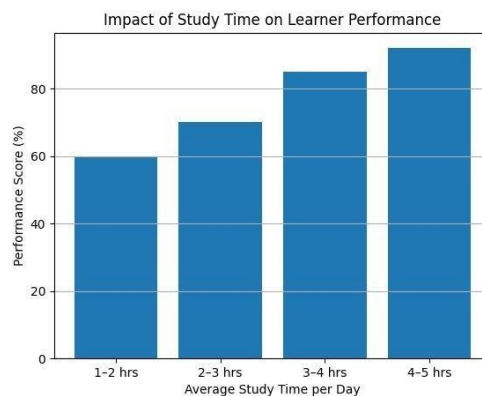


Fig 4: Impact of Study Time on Learner Performance

Performance: Learner performance generally gets better with increasing daily study time. Those students who put in extra hours of concentrated learning not only grasp the concepts more deeply but also have a longer retention of the study material and thus get higher academic grades. This evidence supports that steady and well, organized study routines can significantly impact learning results.

Average Study Time: The study success of students is largely determined by the study time they spend each day. Students who stay longer on their studies tend to be more interested in the material, get more practice, and effectively fill learning gaps. In total, higher study time undoubtedly results in better performance and more efficient learning.

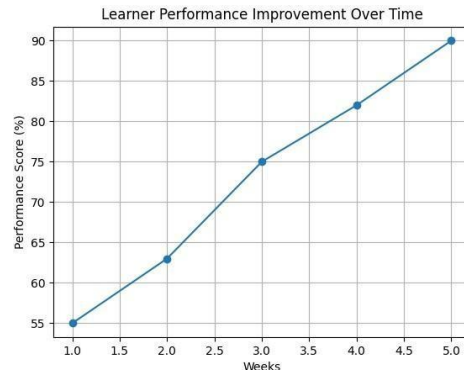


Fig 5: Learner Performance Improvement Over Time

The line graph depicts the learner's gradual performance improvement over a five, week period, where weeks are laid out on the horizontal axis, and performance percentages are given on the vertical. Learners begin with about 55% in the first week, which corresponds to the initial knowledge level, and afterward, they keep on progressing as time goes on, reaching approximately 63% in the second week and 75% in the third week. This gradual improvement pattern indicates that the learner's performance gets enhanced through regular study, constant practice, and increasing acquaintance with the learning material. By the fourth week, the performance score attains almost 82%, which means better understanding and memory of the concepts, and at the fifth week, the scores go up to about 90%, which is a clear indication of very strong learning gains and skill improvement.

Conclusion and Future Work

This work is around designing and implementing an Agentic AI, based Learning Management System capable of adjusting and improving learner engagement in digital learning environments. Integrating essential features like user authentication, content management, learning analysis, AI, driven recommendations, adaptive quizzes, and continuous performance tracking, the system offers a single learner, centered platform. Using agentic AI, the platform analyses how the learners behave, creates tailored learning routes for them, and offers apt and timely feedback; thus, it is very helpful for intrinsically motivated learners and those with a clear goal orientation. The findings have shown that there were remarkably higher levels of learner awareness, motivation, and overall learning effectiveness as against the traditional LMS platforms. The present version has seen the potential of agentic AI in education, but there are definitely plenty of ways to go before such a system is fully secured, data management is scalable and multi, agent coordination is enhanced, thus, system reliability and performance can be further strengthened.

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