Knowledge Management System for Effective Teaching, Learning, and Assessment

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***Abstract*—This paper presents a comprehensive knowledge management system designed to improve teaching effectiveness, student learning outcomes, and assessment practices in educational institutions. The system provides personalized teaching and learning to students. In large institutes, each teacher needs to handle multiple classes, and each class consists of a large crowd. It becomes difficult to review every student's performance in tests, maintain their marks manually, and find good and bad performers in class. In a traditional knowledge management system, there was only theoretical knowledge sharing with notes, PPTs, and YouTube video links. Our project provides an automated system to generate tests and assess students' performance in the tests. Our project is not limited to theoretical knowledge sharing, but it encourages research-based and planned study structures through our various modules. The integration of large language models and agentic AI is changing the face of knowledge management and learning systems. This review examines the architecture, functionality, and theoretical foundations of the system in the context of current educational technology research.**

***Index Terms*—knowledge management system, educational technology, AI in education, automated assessment, personalized learning**

I. Introduction

The digital transformation of education has accelerated in the COVID-19 pandemic era. The need for a learning management system for higher education increased. Institutes started to look for solutions that are not only integrated and secure but also budget-friendly [1]. Institutes started using different tools like Google Classroom, digital forms, and some external providers for formative assessments. The tools were fragmented, and there was no direct connection between them. The teacher had a lot of manual work in it, from creating the test to collecting marks on an Excel sheet and finding good and bad performers, but still, the thing lagging was how to find which topic a particular student or the whole class is lacking. Due to a large external workload, it was hard for teachers to look into students individually and help them out [2].

The study by Thompson et al. (2023) discovered that teacher workload pressure mainly originated from noncore administrative duties, which made teachers feel rushed and unable to handle their tasks. The work pressure factors described by Thompson et al. (2023) include administrative tasks together with extra-curricular demands, unexpected events alongside student support needs beyond scheduled lessons, and excessive communication overheads [3]. The traditional method of assessing student work in coding domains requires extensive manual evaluation followed by feedback. The assessment work required under the flipped model diverts teachers from implementing their main flipped benefits by forcing them to dedicate too much time to grading assignments instead of teaching activities or helping students directly. The time students must wait to receive feedback through manual assessment disrupts their learning process by delaying their ability to address their misconceptions [4].

Institutions require a system for rapidly assessing and evaluating students' performance [5]. Instead of spending time creating their own study materials, teachers should utilize a common resource to provide to students; this enables effective learning while also saving teachers valuable time. Communication between students and teachers should be seamless to achieve better academic results [6]. The system should provide a platform where students and teachers can easily share their views and address doubts. Along with the automated assessment system, ethical practice considerations must be incorporated. The assessment process should not stop at automation; it should also include proctoring [7]. Test results should provide both individual reports and overall class reports, enabling teachers to identify topics that require further instruction [8]. The overall goal is to help students perform better in their final assessments.

II. Survey-Based Requirement Analysis

Results from educational professional and student surveys display in this section that support the need for our proposed Automated Assessment and Progress Tracking System. Educational survey results show essential shortcomings of current practices, together with substantial target market interest in our proposed assessment and tracking system.

A. Teachers Interested in Automation

Figure 1 shows that most of the teachers spend more than 3 hours creating study material and test creation, while more than 4 hours on performance analysis of students. Research indicated that approximately 36 teachers showed a strong commitment to implementing automatic processes for essential teaching responsibilities 2. Approximately 36 teachers were very interested in: Automated Test Generation, Automated Class Reports, and Student Performance Tracking.

Key Insights: Teachers are devoted to reducing manual testing procedures because they consume more than 2–3+ hours of their time, according to 90% survey respondents who strongly or moderately agreed with the need.

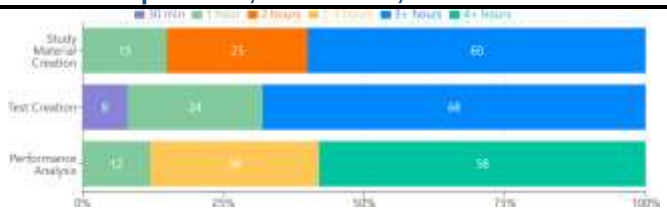

Fig. 1. Faculty Time Allocation Survey (n=40)

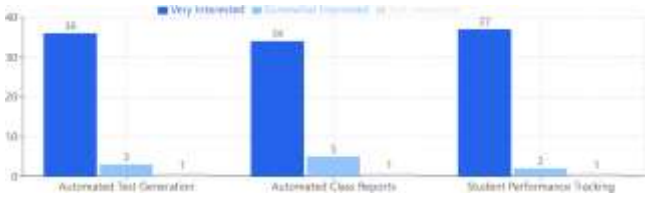

Fig. 2. Faculty Interest in Automated Solutions (n=40)

B. *Student Pain Points in Current Systems*

Study participants observed various difficulties in regular learning institutions. The data demonstrates that 57.75% of students encounter unclear weaknesses because they receive minimal detailed feedback 3. The majority (93.7%) of students showed interest in personalized reports as opposed to minimal Not Interested responses 4. The majority of students at 87.2% wanted more assessments than what was currently available 5.

Key Insight: Research evidence shows students need specific insight into their progress which results in both student disengagement along with learning deficiencies.

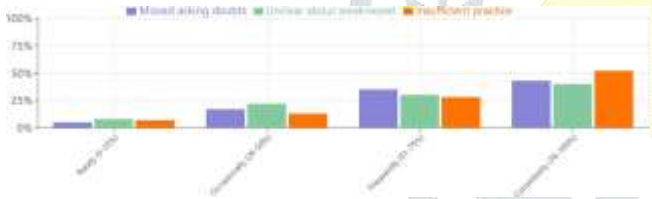

Fig. 3. Student Challenges in Current Educational Environment (n=250)

III. METHODOLOGY

This section explains the research approach for designing and building the integrated educational platform and its technical features alongside proposed operational capabilities. The platform functions as a web application built to boost operational performance and teaching processes and ensure assessment security while delivering specialized support for education and research needs. Protection forms a vital base principle which receives dedicated encryption protocols in the following section. The methodology relies on three core design elements which combine advanced AI features with role-based access and modular structures.

Fig. 4. Student Interest in Personalized Reports (n=250)

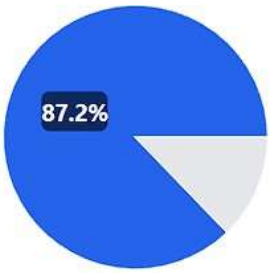

Fig. 5. Student Desire for More Frequent Assessments (n=250)

A. *System Architecture and User Roles*

The platform utilizes a role-based access control system, differentiating between three primary user types:

- **Administrator (Admin)**: Manages institutional registration and bulk user onboarding (teachers, students) via Excel uploads.
- **Teacher**: Creates and manages classrooms, uploads content, generates and oversees assessments, monitors student progress, and interacts with students.
- **Student**: Accesses course materials, participates in activities, takes proctored assessments, views feedback, and utilizes learning/research support tools.

Figure 6 illustrates the system's data flow:

B. *Technology Stack and Implementation*

The system is developed using a modern technology stack chosen for scalability, performance, and flexibility:

The frontend section makes use of React.js to develop an interactive user interface through which developers implement their code in TypeScript and JavaScript to create a responsive interface. The platform uses microservices architecture to process different system functions through Node.js Flask (Python) and Spring Boot (Java) which ensures efficient API handling and database management. Artificial Intelligence (AI)

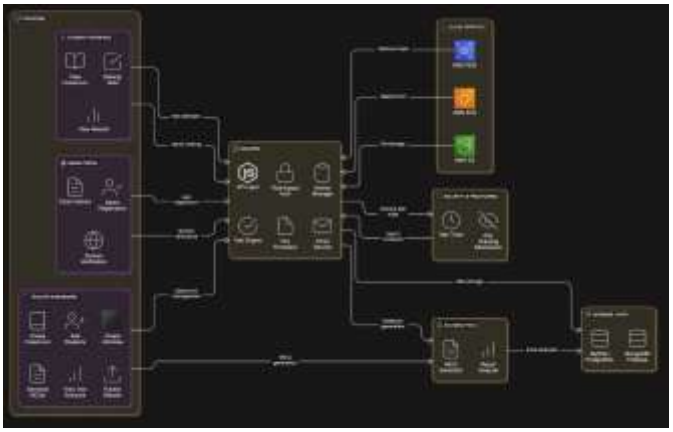

Fig. 6. System architecture diagram showing data flow between components

Models use the cutting-edge large language models GPT-4o from OpenAI and Gemini from Google and Deepseek-70b to fulfill specific tasks after their selection based on their respective performance strengths. The system utilizes SerpAPI, DuckDuckGo and Firecrawl APIs as part of its Web Surfing capabilities for real-time web searching needed by resource discovery modules.

C. Core Modules and Functionalities

The platform integrates several distinct modules:

- **Institutional and User Management Module**: Through Excel file uploads the system enables the Admin to establish institutions and oversee user management in a streamlined manner. Teachers possess the ability to handle student enrollment procedures specifically for their own teaching spaces.
- **Classroom Activity and Content Management Module**:The system provides educational tools that let teachers build digital classrooms which they can fill with various activities for sharing notes while creating assignments and conducting automated assessments.
- **Automated Assessment Generation Module**: The system uses AI technology to convert educational content provided by teachers into automated tests. The system enables teachers to upload presentation files as their input using PPT as an example. AI Processing involves the system's use of advanced AI model (Gemini) and NLP techniques to process content for creating suitable assessment questions. Educators define assessment specifications including the level of difficulty between Easy and Hard and a question range from 5 to approximately 25.
- **Proctored Assessment and Reporting Module**: The system handles safe tests delivery and evaluation processes. Assessments function through a full-screen delivery system that has disabled both copy/paste options. The system delivers alerts followed by possible test interruption when users change application windows. The system creates both immediate student-specific reports that teachers can publish and comprehensive reports which identify to educators which topics require additional teaching support along with supplementary resources.
- **Learning Path Generator Module**: The system provides individualized instruction direction to learners through its AI agent-based solution. A separate AI agent system works together after processing input topics according to its workflow design. A single agent develops the organized educational route. The agent uses Web Surfing APIs including SerpAPI and DuckDuckGo to discover appropriate educational materials which are found in articles and tutorials. The third agent within the system identifies suitable free and paid courses which provide practical and theoretical aspects for deeper learning. Deepseek-70b carry out the operations of these agents which specialize in information synthesis and resource discovery.
- **Research Support Modules**: The system includes tools which help students particularly those who are new to research through the use of specific AI automation. An AI agent accesses web surfing APIs (SerpAPI) to find relevant free research papers that match a user-submitted topic and create connections between them. The dummy research paper creator uses a combination of artificial intelligence agents which potentially integrate GPT-4o for its operations. Multiple agents draft particular pieces of content (such as Abstract, Related Work, Introduction, Methodology mock-ups) which reflect academic standards after receiving a brief research summary from the user.

D. Security Measures

The system uses strong security protocols that extend to all its components: RS-256 encryption safeguards data information both when it is moving across the network and when the data exists in a resting state. The system uses an original image encryption method to protect sensitive visual content which includes proctoring captures and uploaded content elements.

E. Ethical Considerations

The system implementation bases its structure on ethical foundations. These security measures alongside transparency about proctoring components (student warning messages) and protected assessment confidentiality, along with user data integrity, represent core ethical design elements.

IV. Results

This section evaluates student performance and teachers' convenience after using the proposed system.

A. Faculty Experience and System Impact

The introduction of automated learning technology resulted in significant advantages for teaching personnel who worked with the system across various aspects. Figure 7 illustrates the time-saving benefits of the system which reduced test creation by 75% from 180 minutes to 45 minutes and performance

analysis by 75% from 240 minutes to 60 minutes and cut material preparation time by 60% from 200 minutes to 80 minutes. Each faculty member gained 9.5 hours weekly for educational activities and teaching improvements through this efficiency boost.

The system received affirmative feedback from teaching staff who participated in satisfaction surveys. The survey results in Figure 8 demonstrated that 90% of faculty members were satisfied with the system implementation with ”Very Satisfied” receiving 68% and ”Satisfied” receiving 22% of responses but ”Dissatisfied” only received 3%. The main drivers of faculty satisfaction emerged from both improved efficiency and decreased administrative workloads according to qualitative feedback.

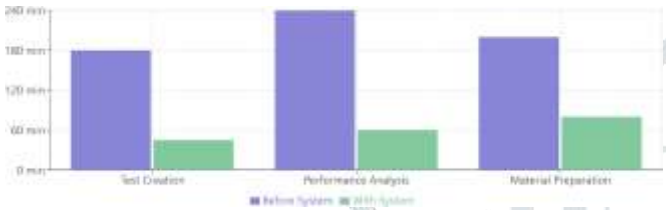

Fig. 7. Average Time Spent on Tasks (Minutes) Before vs. After System Implementation

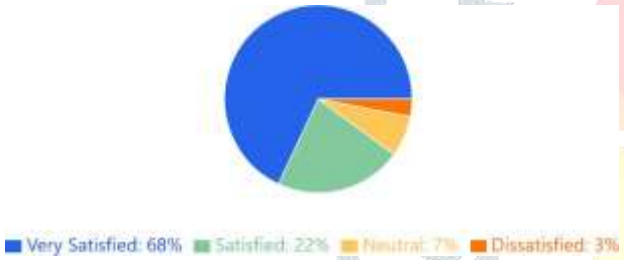

Fig. 8. Teacher Satisfaction with System (n=40)

B. Performance Trends Across Test Iterations

This section analyzes five student archetypes named Strong Performer, Steady Improver, Slow Learner, Late Bloomer and Inconsistent, which were selected through stratified sampling based on their academic record history. The participants were chosen based on their academic characteristics, which were analyzed through two assessment methods. The assessment records from formative assessments of the previous semester served as one of the evaluation criteria, and their scores in the final exam.

These archetypes represent the full spectrum of observed learning trajectories in our pilot cohort:

- **Strong Performer**: Low performance growth, as already excelling in all tests. Showed an increment of 8-9% overall.
- **Steady Improver**: Moderate performance growth between testing sessions with increases amounting to 5-6%.

TABLE I
PERFORMANCE TRENDS ACROSS TEST ITERATIONS (NUMBER OF CORRECT ANSWERS)

Test No.	Strong Performer	Steady Improver	Slow Learner	Late Bloomer	In-consistent
Test 1	9	6	3	4	8
Test 2	9	7	4	5	5
Test 3	10	7	5	6	9
Test 4	10	8	6	8	6
Test 5	9	9	8	9	7

- **Slow Learner**: Similar performance growth as steady performer but lower in marks.
- **Late Boomer**: Started with below average marks but performed very well in the last two tests.
- **Inconsistent**: Performed well in some tests but made mistakes in tests in between good performance.

V. CONCLUSION

This knowledge management system advances educational technology by integrating various AI-powered components, which create support for educational activities from teaching to learning and assessment. The automated system frees educators to undertake valuable pedagogical work because it handles standard tasks such as test creation and performance evaluation therefore students get tailored educational experiences. The system becomes more useful for the educational continuum through its integration of research support tools. Modern educational institutions need these complete platforms to mold the way education will appear in the future as they pursue digital transformation.

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