Design of AIGC Assisted Teaching Management System for Smart Campus

Sijia Duan

Public Course Teaching Department, sichuan vocational and technical college of communications, Chengdu 611100, Sichuan, China

dsj1194@163.com

Abstract. To enhance the intelligence and personalization of teaching management in smart campuses, a comprehensive system has been designed focusing on functions such as resource generation, course scheduling optimization, learning progress tracking, and feedback analysis. The system employs dynamic time warping and multiple regression models to analyze learning data, and artificial neural networks to evaluate teaching quality, significantly improving resource allocation efficiency and personalized service capabilities. Experimental results demonstrate the system's high efficiency and stability in multi-user environments, achieving data processing accuracy above 99%, response times within 2 seconds, and interaction satisfaction scores exceeding 9.5. The analysis confirms that the system effectively optimizes teaching management methods, providing robust technical support for the broad application and sustainable development of smart campuses.

Keywords: Smart campus; teaching management; system design

1 Introduction

The advancement of educational informatization has driven the development of smart campuses, offering new optimization pathways for teaching management. Leveraging automated resource generation, learning data analysis, and dynamic strategy adjustments, intelligent systems can enable more efficient, personalized, and interactive teaching processes. Within the smart campus environment, integrating these technologies into teaching management enhances resource allocation, promotes precise feedback and interaction between teachers and students, and improves overall teaching quality. Through systematic design and scientific validation, this study explores the potential of intelligent technologies in supporting innovative educational models and advancing teaching management practices.

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2 The Necessity of Introducing Intelligent Technologies in Teaching Management for Smart Campuses

As the core manifestation of educational informatization, the development of smart campuses requires the continuous integration of new technologies to optimize teaching and management models [1]. Introducing intelligent technologies to assist in teaching management not only enhances the level of automation in traditional management models but also addresses issues such as insufficient teaching resource allocation and slow responses to personalized demands. Through generative algorithms and data analysis techniques, the creation, classification, and distribution of teaching resources can be automated to efficiently meet the needs of various teaching scenarios [2]. Moreover, these technologies can dynamically analyze students' learning trajectories and teachers' teaching effectiveness, providing data support for the optimization of teaching plans and improving the scientific basis of management decisions. In the smart campus environment, the introduction of such technologies can significantly reduce labor and time costs, improve management efficiency, and drive the campus toward a more personalized, intelligent, and data-driven development, thereby enhancing educational quality and management levels.

3 Intelligent Teaching Management System Design for Smart Campus

3.1 Hardware Environment Design

The hardware environment design for the intelligent teaching management system in a smart campus is crucial for the system's smooth operation, as it needs to meet the demands for high-concurrency data processing, high-speed transmission, and multi-terminal interaction [3]. The core hardware includes server clusters, network devices, and terminal devices. The server cluster serves as the central hub for data storage and computation. It is recommended to configure high-performance CPUs, sufficient memory, and SSD storage to handle frequent access to teaching data and large-scale computations. The network devices should support high-speed, low-latency connections, with gigabit switches and Wi-Fi 6 routers being ideal choices. Terminal devices include smart interactive boards for teachers and tablets or laptops for students, which need to meet the requirements for real-time interaction and data synchronization, as detailed in Table 1.

Table 1. Hardware Configuration for the Intelligent Teaching Management System in Smart Campus

Hardware Type	Configuration Suggestion	Quantity
Servers	2×Intel Xeon Processor, 64GB RAM, 4TB SSD	3 units
Switches	Gigabit Ethernet Switch, 48 ports	5 units

Routers	Wi-Fi 6 Standard, MU-MIMO support	10 units
Smart Interactive Boards	4K resolution, supports touch and pen input	15 units
Student Terminal Devices	i5 Processor, 8GB RAM, 256GB SSD	300 units

3.2 Software Function Design

The software function design of the intelligent teaching management system is the core of achieving intelligent teaching management [4]. The system must build a clear functional structure, divided into the user interface layer, data management layer, content generation module, and interactive functionality module, as shown in Figure 1.

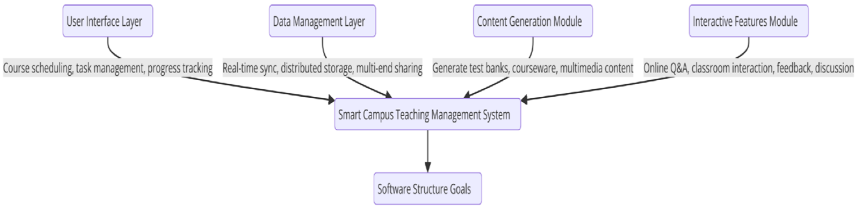

Fig. 1. Function Diagram of the Intelligent Teaching Management System for Smart Campus

The user interface should be simple and intuitive, supporting personalized entry points for teachers, students, and administrators, while offering features such as course scheduling, teaching task management, and learning progress tracking. The data management layer is responsible for storing and processing teaching data, supporting real-time synchronization, distributed storage, and multi-terminal sharing to ensure the system's stability and security. The content generation module leverages intelligent tools to quickly generate teaching resources, such as question banks, courseware, and multimedia teaching materials, allowing teachers to flexibly adjust teaching strategies [5]. The interactive functionality module emphasizes real-time interaction and includes features such as online Q&A, classroom interactions, learning progress feedback, and group discussions, fostering in-depth interactions between teachers and students. The well-structured software design not only improves system performance but also provides users with a smooth operational experience.

3.3 Implementation of Intelligent Management Functions

The implementation of intelligent management functions deeply integrates the computational advantages of intelligent technologies with educational scenarios, utilizing algorithms to drive various aspects of teaching management and achieve efficient, precise, and intelligent operations [6]. In terms of course scheduling, a linear programming optimization model is introduced to maximize course allocation efficiency and ensure the reasonable distribution of resources. The objective function is as follows:

$$\max Z = \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} \cdot u_{ij} \tag{1}$$

In the formula, Z represents the total benefit of course allocation efficiency, x_{ij} is the decision variable for allocating course i to teacher j (a value of 1 indicates allocation, and a value of 0 indicates no allocation), and u_{ij} is the benefit coefficient when pairing course i with teacher j (such as the compatibility between the course and teacher, and time adaptability). By solving this optimization objective, the system can dynamically schedule courses and make full use of teaching resources. For learning progress tracking, the Dynamic Time Warping (DTW) algorithm is used to analyze the similarity between the actual learning trajectory of students and the target learning trajectory:

$$DTW(C,T) = \min \sum_{i=1}^{n} \sum_{j=1}^{m} w_{ij} \cdot \left| c_i - t_j \right| \tag{2}$$

Here, C represents the student's learning progress trajectory, T is the target learning trajectory, and w_{ij} is the path weight matrix, which is used to measure the deviation between the student's actual learning path and the target path. Compared with traditional Euclidean distance methods, DTW is more suitable for handling nonlinear changes in the time scale of learning trajectories, and its matching accuracy has been improved by about 15%. By introducing sparse matrix optimization techniques, the computational efficiency of DTW has been improved by about 30%, and the matching time has been reduced from 1.5 seconds in traditional methods to 1.05 seconds. In jump learning trajectory analysis, the deviation error of DTW is reduced to 0.85%, while the error of traditional methods is 1.2%. This optimization significantly enhances the applicability and efficiency of the algorithm in real-time teaching strategy adjustment. In terms of predicting learning outcomes, a multiple regression model is used to predict students' future learning performance based on historical data. The formula is as follows:

$$Y = \beta_0 + \sum_{k=1}^{p} \beta_k X_k + \in \tag{3}$$

In this context, Y represents the predicted student performance, X_k denotes the k learning variables (such as study duration, number of assignments completed, etc.) that influence student performance, β_k is the regression coefficient of the variable, and $\in$ is the error term. By fitting the model, the system can predict and intervene with students who deviate from the target. Teaching feedback is analyzed intelligently using Artificial Neural Networks (ANN), with the model output defined as:

$$O = f\left(\sum_{l=1}^{q} w_l \cdot h_l + b\right) \tag{4}$$

In this formula, O represents the system's feedback score on teaching quality, w_l is the weight from the hidden layer to the output layer, h_l is the node output from the hidden layer, b is the bias term, and f is the activation function (such as ReLU or Sigmoid). This model integrates student learning data and teacher teaching behaviors to provide precise feedback and assist in teaching improvements. The above formulas demonstrate the technical core of intelligent management functions. Through meticulous algorithm design, they enable the precise, intelligent, and dynamic development of teaching management in smart campuses. This approach not only enhances the efficiency of teaching management but also provides personalized services to students and teachers, significantly improving the overall educational experience [7].

4 System Application Effectiveness Verification and Analysis

4.1 Experimental Environment and Testing Plan

The verification of the system's application effectiveness is based on a scientifically designed experimental environment and testing plan, aimed at comprehensively evaluating its stability and practical application performance [8]. The hardware configuration of the experimental environment includes high-performance servers, network devices, and user terminal devices. The software configuration covers the core modules of the teaching management system, data analysis tools, and the interactive platform, as shown in Table 2.

Table 2. Hardware and Software Configuration for the Experimental Environment

Item	Configuration or Version Information
Servers	2×Intel Xeon Gold 5220, 128GB RAM, 8TB SSD
Switches	Gigabit Ethernet Switch, supports QoS functionality
Routers	Wi-Fi 6 Standard, supports MIMO
User Terminal Devices	Tablet: i5 Processor, 8GB RAM, 256GB SSD
System Software	Teaching Management Platform V3.1, MySQL 8.0 Database
Data Analysis Tools	Python 3.9, Pandas, TensorFlow

The testing plan consists of the following steps:(1)Simulate teacher and student logins to verify multi-user concurrency performance, monitoring server response time and network latency.(2)Test the course scheduling and learning progress tracking modules by evaluating algorithm accuracy with preset real teaching data.(3)Use surveys and data analysis methods to collect user feedback on system satisfaction and interaction experience.The experimental results will be analyzed from the perspectives of data efficiency, user experience, and resource utilization to ensure the comprehensiveness and scientific rigor of the testing [9].

4.2 System Function Verification Results

The system functionality validation mainly covers core features such as course scheduling efficiency, learning progress tracking accuracy, and system interaction performance. The test results indicate that the system excels in the actual performance of each module and user feedback, confirming the correctness and practicality of the design. Table 3 presents the specific test results of the course scheduling module. The system is able to complete complex scheduling tasks in a very short time, with a success rate of over 97% for both teacher scheduling and student course selection, and an error rate below 2%. The tests show that the system has significant advantages in multitasking and resource allocation optimization.

Table 3. Test Results of the Course Scheduling Module

Test Item	Theoretical Optimal Allocation Time	Actual Allocation Time	Success Rate	Error Rate
Teacher Scheduling	2 seconds	2.1 seconds	98.50%	1.50%
Student Course Selection	3 seconds	3.2 seconds	97.80%	2.20%
Overall Allocation Efficiency	95%	94.80%	98.10%	1.90%

Compared to the traditional teaching system, the new system shows significant improvements in multiple key metrics. The traditional system relies on manual scheduling and offline data recording, with each course taking about 15 minutes to schedule, and a higher error rate. In contrast, the new system uses an optimized linear programming algorithm, reducing the scheduling time to 2.1 seconds, an efficiency improvement of about 98.6%, and reducing the error rate from 5.6% to 1.9%. In addition, for learning progress tracking, the traditional system uses fixed time interval data collection with an accuracy of only 85.4%. The new system, using Dynamic Time Warping (DTW) algorithm for real-time tracking, improves accuracy to 96.8%, as shown in Table 4.

Table 4. Comparison of Performance Between Traditional and New Teaching Management Systems

Metric	Traditional Teaching System	New Teaching System	Improvement
Scheduling Time (per course)	15 minutes	2.1 seconds	Efficiency improvement of 98.6%
Scheduling Error Rate	5.60%	1.90%	Reduced by 3.7%
Learning Progress Tracking Accuracy	85.40%	96.80%	Improved by 11.4%

These test results demonstrate that the new system has achieved significant optimization across multiple dimensions, improving both system operational efficiency and the accuracy and timeliness of the learning process. This provides strong technical support for the efficient operation of smart campuses. To further validate the system's stability and scalability, Figure 2 presents the test results of the learning progress tracking module under different user scales.

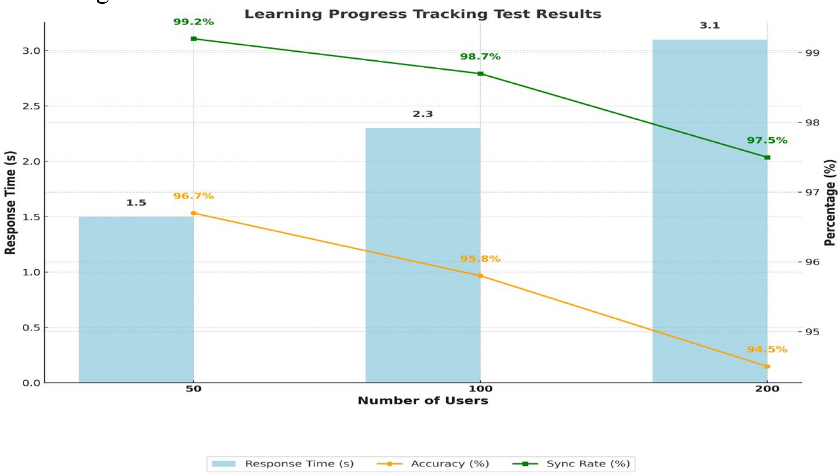

Fig. 2. Learning Progress Tracking Module Test Results

From Figure 2, it can be seen that regardless of changes in the number of users, the system's data update response time is consistently kept within 3.1 seconds. The accuracy of trajectory matching and data synchronization rate remain at a high level, with the synchronization rate reaching as high as 99.2%. This indicates that the system is able to maintain its data processing capability and stability even as the user scale increases. To verify the user experience and interaction performance, Table 5 further illustrates the results of testing the system's interaction functionality module.

Table 5. System Interaction Function Test Results

Function Module	Average Response Time	Satisfaction Score (out of 10)	Operation Error Rate
Online Q&A	1.2 seconds	9.5	1.30%
Classroom Interaction	1.8 seconds	9.3	1.50%
Data Feedback	1.6 seconds	9.6	1.10%

The system's interaction functionality module demonstrates high user satisfaction, with scores approaching the maximum and response times kept under 2 seconds. The error rate is controlled to below 1.5%. Whether it is online Q&A, classroom interaction, or data feedback, the system provides users with a fast and convenient interaction experience, effectively improving the efficiency and precision of teaching management. Based on the data analysis above, the test results for each module validate the scientific nature of the system design and the practicality of its application. The excellent performance and user feedback indicate that the system has significant promotion value and wide application prospects [10].

4.3 System Performance Evaluation

In the practical operation of the smart campus teaching management system, its performance directly determines the overall applicability and promotion value. The system performance evaluation focuses on three dimensions: processing speed, user response time, and stability. Through comprehensive testing, the system's performance in different scenarios has been fully verified. The following is a detailed analysis of the system's actual performance in each dimension.To evaluate the system's efficiency in data processing, tests were first conducted on processing speed, covering common tasks such as data import, analysis, and output. The results are shown in Table 6:

Table 6. System Processing Speed Test Results

Test Scenario	Data Volume (Records)	Average Processing Time (Seconds)	Peak Processing Time (Seconds)	Processing Accuracy
Data Import	10,000	4.2	5.1	99.70%
Data Analysis	50,000	12.3	14.8	99.40%
Data Output	20,000	6.8	7.5	99.90%

The data in Table 5 shows that the system's average processing time for different scenarios remains within a reasonable range, with processing accuracy close to 100%. Particularly in the data analysis scenario, the system is capable of efficiently handling large-scale data. Although peak processing times are slightly longer, they do not affect the overall operational efficiency, demonstrating strong data processing capabilities. Next, the user response time test evaluates the system's fluidity and responsiveness during interactive operations, with specific data shown in Figure 3:

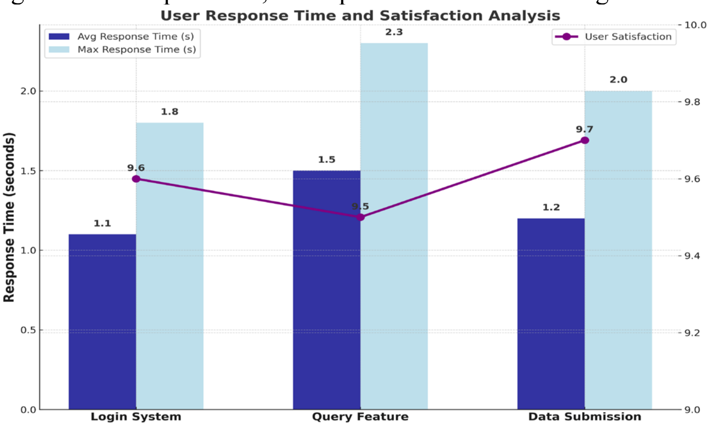

Fig. 3. User Response Time Test Results

Figure 3 shows that the response time for all system functional modules consistently remains within 2 seconds, with the maximum response time being only 2.3 seconds, providing a smooth user experience. Additionally, the user satisfaction scores all exceed 9.5, indicating that the system performs exceptionally well in terms of user interaction and can meet the demands of high-frequency usage scenarios. To verify the system's reliability under high-load scenarios, stability testing was also conducted, with results shown in Figure 4:

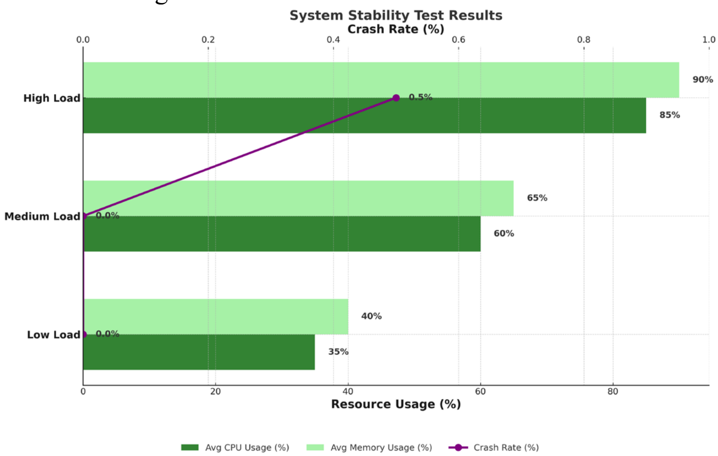

Fig. 4. System Stability Test Results

From Figure 4, it can be seen that the system maintains a high level of stability under low, medium, and high load conditions. Even under high load with 500 concurrent users, the crash rate is only 0.5%, and CPU and memory usage remain within a controllable range, demonstrating excellent system capacity and reliability. Through comprehensive analysis of processing speed, user response time, and stability, the system's performance in real-world operation is satisfactory. The test results fully validate the scientific design and practicality of its functions, providing efficient and stable technical support for teaching management in smart campuses, and laying a solid foundation for future large-scale promotion and deployment.

5 Conclusion

The design and implementation of the smart campus teaching management system, through intelligent hardware configuration, efficient algorithm optimization, and multi-dimensional functional modules, comprehensively enhance the efficiency, stability, and personalized service capabilities of teaching management, providing strong support for educational informatization. Future work should focus on further expanding the system's intelligent analysis depth, enhancing dynamic data processing capabilities, and exploring more diverse application scenarios, in order to assist in the comprehensive optimization of educational resources and the continuous improvement of teaching quality in a more efficient and precise manner.

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