

The Application and Optimization Design of Management Information Systems in the Field of Higher Education in China

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Abstract: Digital transformation has made management information systems (MIS) increasingly vital in education. This paper examines the current application and optimization of MIS in higher education in China. Information technology has enhanced educational management efficiency and decision-making through MIS. However, Chinese universities face the problems of data silos, incomplete functionality, and low user satisfaction. This study, through literature review and field investigation, analyzes the application of MIS in universities domestically and internationally, identifies issues in Chinese universities, and proposes optimization solutions. The focus is on enhancing MIS in Chinese universities with modern technologies like artificial intelligence to improve management efficiency and service quality.

Keywords: Management Information System, Educational Management Information System, Educational Technology, Educational Management.

1. Introduction

The rapid development of global information technology has led to the widespread application of management information systems (MIS) across various industries. In higher education, MIS is crucial for knowledge innovation and talent cultivation, improving educational management efficiency, and supporting school decision-making. Many universities in developed countries have successfully used MIS to optimize teaching resources, streamline administrative operations, and enhance teacher-student interactions. However, MIS application in Chinese higher education is still nascent, with many challenges and opportunities for optimization.

This paper explores the current application and optimization design of MIS in Chinese higher education. It proposes practical optimization schemes based on current analysis. Technologically, the paper recommends introducing artificial intelligence and big data analysis to enhance MIS intelligence and data processing capabilities. Management measures include strengthening system integration and

optimizing user interface design to advance MIS application and development in Chinese higher education.

2. Overview of Management Information Systems in the Field of Education

2.1. Definition and Basic Concepts of Management Information Systems

Management information system is an integrated user machine system consisting of five aspects: hardware, software, data, people, and processes. It supports organizational management, decision-making, and control by collecting, processing, storing, and disseminating information. The core goal of MIS is to improve management efficiency and decision-making quality, and help organizations achieve their strategic goals. MIS reduces manual errors and improves the accuracy and timeliness of information by automating and optimizing information flow, thereby enhancing the overall operational efficiency of the organization. (Saani, 2019)

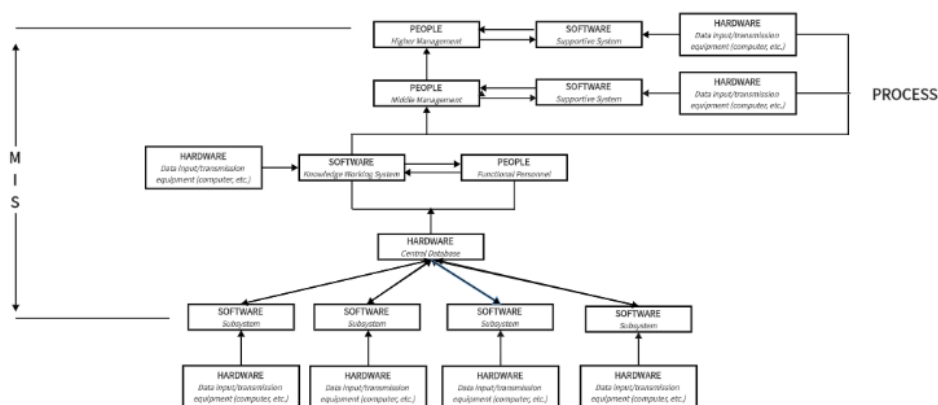


Figure 1. Conceptual diagram of management information system

2.2. Definition and Characteristics of Management Information Systems in The Field of Education

The use of Management Information Systems (MIS) in the field of education aims to support the management and decision-making of schools and educational institutions by collecting, processing, storing, and disseminating educational management data. It includes traditional functions such as student information management, course management, and financial management, as well as modern teaching support, resource optimization, and administrative management. The core goal of MIS is to improve management efficiency and enhance educational quality and teaching effectiveness. (Syarwani & Syahrani, 2022)

MIS has characteristics such as data integration, real-time performance, user friendliness, efficiency, and security in the field of education. It can integrate data from students, teachers,

administration, courses, finance, etc., manage and query them through a unified platform, and update them in real time to ensure timely and accurate information, providing decision support for managers. The design focuses on user experience, with a user-friendly interface and easy operation, making it easy for teachers, students, and administrators to use and reducing technical barriers. MIS improves management efficiency, reduces manual operation time and errors, and has strict permission management and data encryption functions through automated data processing and report generation, ensuring data security and privacy. MIS also has scalability and adaptability and can expand and upgrade its functions with changes in educational needs and technological advancements. A comprehensive education MIS system typically includes main functional modules such as student information management, teacher and staff management, campus administrative management, and student parent management.

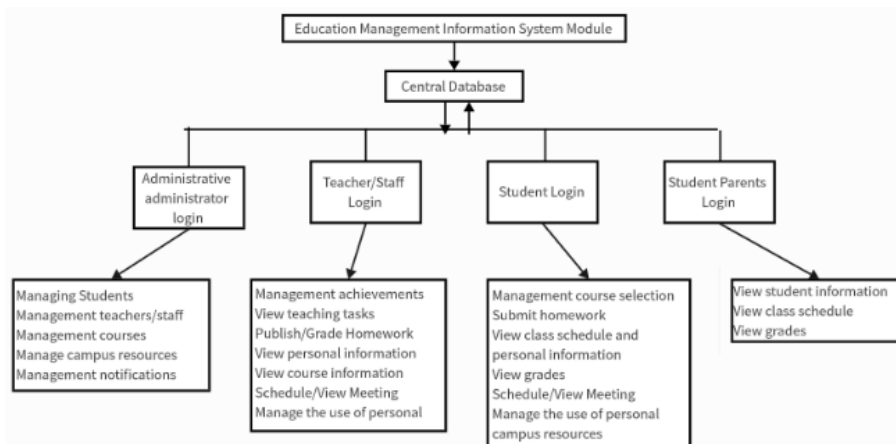


Figure 2. Main Functions and Modules of the Education Information Management System

3. The Application of Management Information Systems in the Field of Higher Education in Global and China

To understand the current application status and optimization needs of management information systems in the global and Chinese higher education fields, this study adopted multiple data collection methods to ensure scientificity and representativeness. In addition, this study conducted in-depth interviews and selected some university managers and IT technicians to understand the actual application situation, existing problems, and improvement suggestions of MIS system. Through face-to-face communication, obtain detailed information and gain a deeper understanding of the operation of MIS systems in universities. In terms of data analysis, the questionnaire survey data mainly adopts statistical analysis methods, including descriptive statistics, correlation analysis, and regression analysis, to reveal the key factors that affect user satisfaction. The interview data is analyzed qualitatively through coding and thematic analysis to extract key questions and suggestions, gain a deeper understanding of user needs, and provide support for optimizing the design.

Management Information Systems (MIS) are increasingly popular in higher education worldwide. Many U.S. universities use a combination of Student Hub and Canvas to provide comprehensive management and learning platforms.

Student Hub is a comprehensive student management system, while Canvas is a powerful Learning Management System (LMS) developed by Instructure.

Student Hub manages academic and administrative affairs, centralizing students' academic records, course schedules, and financial information. It provides a unified portal for students, faculty, and administrators to access registration, grades, tuition payments, and more, improving management efficiency (Weeden & Cornwell, 2020). Canvas enhances teaching quality and learning experiences with online tools for discussions, chats, video conferences, quizzes, assignment submissions, and grading management, promoting interaction and participation. Canvas's mobile application allows access to course content anytime, anywhere, aligning with the mobile trend in modern education. The use of Student Hub and Canvas in American universities demonstrates MIS's potential to improve the management of student information and teaching resources in higher education. (Oudat & Othman, 2024)

In the higher education stage in China, management information systems have been widely used in the daily work of students, faculty, administrative staff, and student parents. According to survey data, 92% of respondents use the on-campus management information system at least three times a month. Students can easily check their grades, select courses, and handle various affairs through the MIS system; Faculty members utilize the system for teaching management, scientific research management, and human resource management; Administrative management personnel rely on

MIS systems to improve school management efficiency and decision support capabilities; Although the popularity of management information systems in universities is very high, the overall usability evaluation of the system is not high, with only 25% of respondents satisfied; Secondly, only 27% of users believe that the system is very easy to use, while 28% of users find it difficult to use; Finally, in the survey on the effectiveness of the system, only 23% of respondents believed that the system was very effective.

4. Problems in the Application of Management Information Systems in the Field of Higher Education in China

4.1. Low System Integration Leading to Data Silos

The low level of system integration and the resulting data silos are the main challenges in the application of MIS systems in Chinese universities. Data silo refers to the inability of different departments or systems to communicate and share data, forming independent data storage units, resulting in information isolation and resource waste. The phenomenon of data silos increases the complexity of data management, affects the ability of managers to obtain comprehensive and accurate information, and thus affects the scientificity and effectiveness of decision-making. The lack of effective data sharing mechanisms makes it difficult for them to make accurate decisions when allocating educational resources. A survey shows that 33% of users believe that MIS systems are not integrated with other systems at all, and 32% of users often encounter data silos. In most universities in China, there is no integration between MIS systems, library systems, and laboratory management systems, which leads to the inability to communicate information and increases workload and management difficulty. Teachers at a comprehensive university in a western region have reported that their academic management system and library management system are unable to share students' borrowing information, resulting in a lack of necessary data support for evaluating students' comprehensive qualities.

4.2. Lack of Deep Analysis and Automatic Generation Functions

The lack of deep analysis and automatic generation functions is a significant issue in the management information systems of higher education in China. Modern management information systems should not only have basic data storage and management functions, but also provide powerful data analysis capabilities and automated report generation functions to support school decision-making and management. Many universities have insufficient data analysis capabilities in their management information systems. These systems often only perform basic data queries and statistical analysis, making it difficult to support complex, multidimensional data analysis needs. For example, the system can only display students' final grades and cannot analyze students' learning trends and performance changes. This makes it difficult for teachers to promptly identify students' academic problems and provide targeted assistance. In terms of teacher performance evaluation and management, existing systems can only record basic information and teaching tasks of teachers, and cannot conduct comprehensive

performance evaluation and analysis, making it difficult to objectively and fairly evaluate teachers' work performance.

Secondly, the lack of automatic generation function is also an important issue. An ideal management information system should be able to automatically generate various reports and analysis results, thereby reducing the workload of management personnel and improving work efficiency. However, many existing systems have weak capabilities in this area, requiring managers to manually organize and analyze data, which is time-consuming, labor-intensive, and prone to errors. For example, in terms of resource optimization and allocation, many MIS systems used in Chinese universities cannot allocate laboratory and equipment resources reasonably according to the progress and needs of scientific research projects, which leads to resource waste and inefficient management. In terms of financial management functions, many systems are unable to provide automatic generation of financial statements and budget forecasting capabilities.

4.3. Data Loss and Leakage Caused by Website Instability

The instability of system websites is one of the main problems faced by Chinese university management information systems, leading to data loss and leakage. Website instability manifests as crashes, slow response times, frequent server errors, and system lag. A survey shows that over 65% of students have experienced website lag or crashes, 85% of students have lost files while uploading data, and 40% of students have experienced or are aware of data breaches at their school.

Unstable websites directly affect data transmission and storage, leading to real-time data update failures, database synchronization interruptions, and data loss during backup processes. Many operations require real-time data updates, such as entering student grades and updating student status information. If the website crashes or freezes, the system cannot save information in a timely manner, resulting in data loss. The university management information system relies on distributed databases, and unstable websites can interrupt data synchronization, resulting in data inconsistency or loss. For example, borrowing information in the library management system needs to be synchronized between different databases, and unstable websites can affect normal management and borrowing services. Unstable websites during data backup may also cause backup interruptions or data damage, making it impossible to recover some student profile information.

In addition, website instability also increases the risk of data leakage. When data transmission is interrupted, the system may resend data, which may be intercepted by malicious third parties. Unstable websites can cause system response delays or errors, expose security vulnerabilities, and make them vulnerable to hacker attacks and unauthorized access.

4.4. Insufficient Applicability and Personalized Customization Capability of The System

In the management information system of higher education in China, the insufficient applicability and personalized customization ability of the system is a common problem. This issue not only affects the efficiency of the system, but also hinders its widespread application and promotion to a certain extent. There are differences in management needs among different universities, and standardized management

information systems are difficult to meet the personalized needs of each school. For example, some systems cannot flexibly adjust functional modules or interface layouts, resulting in schools needing to make a lot of manual adjustments and adaptations during use, which increases the workload. In addition, the management information systems used in Chinese universities often lack mobile applications, and many students are unable to log in using their phones or tablets. They must operate on a PC, which causes great inconvenience.

5. Optimization Design of Management Information Systems Used in the Field of Higher Education in China

5.1. Basic Principles of Optimization Design

In response to the problems of Management Information Systems in the field of higher education in China, optimization design should follow these basic principles to ensure the efficiency, integration, and user experience improvement of the system. Firstly, the system should be highly integrated to ensure that data between subsystems can be shared and exchanged, eliminating data silos. Secondly, MIS system functions should comprehensively cover all aspects of educational management and meet the diverse needs of users. Finally, the system design should be user centered, with a user-friendly interface, easy operation, and improved user satisfaction and efficiency.

5.2. Use Big Data Platforms to Centralize Data and Eliminate Data Silos Caused by Low System Integration

Big data technology can play an important role in addressing the issues of low system integration and data silos (Cu et al., 2020). By establishing a unified big data management platform, data from various departments and systems can be centrally stored and managed, thereby eliminating the phenomenon of data silos. Utilizing data warehouse technology to integrate data scattered across various systems into a unified platform, facilitating data sharing and querying. For example, integrating the academic management system with the library management system allows teachers to access students' borrowing records when evaluating their overall quality, providing more comprehensive data support. Strengthening data sharing and collaboration between systems is also the key to solving the problem of data silos.

Secondly, adopting integrated middleware technology can effectively enhance the integration level of the system. By introducing Enterprise Service Bus (ESB) technology, independent systems are connected to achieve data interoperability and sharing. ESB provides a flexible and scalable integration framework, making data exchange between different systems more efficient and reliable.

5.3. Introducing Artificial Intelligence Analysis to Support Deep Analysis and Warning Functions

To address the issues of functional deficiencies and imperfections, artificial intelligence (AI) technology can provide powerful support, enabling deep academic analysis and warning, personalized education guidance, resource optimization and allocation, financial reporting and budget

forecasting, teacher performance management, and other functions. The implementation steps include requirement analysis, evaluation of existing system functions, and determination of AI functional modules that need to be introduced. Develop and train AI models to achieve deep academic analysis and warning functions, capable of analyzing students' learning data, identifying potential problems, and issuing warnings. Combining natural language processing technologies such as ChatGPT, develop a personalized education guidance module that provides learning advice and resource recommendations for students. Develop AI algorithms to achieve intelligent resource management and allocate laboratory and equipment resources reasonably based on the progress and needs of scientific research projects. Develop an AI driven financial management module to automatically generate financial statements and make budget forecasts. Develop AI models to achieve multidimensional analysis and evaluation of teacher performance, providing objective and fair evaluation criteria. Integrate various AI functional modules into the existing MIS system and conduct comprehensive testing to ensure the stability and accuracy of each module.

5.4. Using Blockchain Technology to Solve Data Loss and Leakage Problems Caused by Website Instability

The characteristics of blockchain technology include decentralization, immutability, and transparency (Ghosh et al., 2020). Decentralization makes blockchain networks composed of multiple nodes, each holding a complete copy of data without relying on a single server or data center, thus avoiding the problem of single point of failure. The immutability ensures that once data is written into the blockchain, it cannot be arbitrarily modified or deleted, greatly enhancing the integrity and security of the data. Transparency and traceability ensure that all transaction records on the blockchain are public, and every data modification is traceable, ensuring the transparency of operations.

The use of blockchain technology can effectively solve the problem of website instability. Firstly, through distributed data storage, important data in the management information system is stored on the blockchain, with each node retaining a complete copy of the data. Even if a node fails, the data can still be obtained from other nodes, ensuring high availability and reliability of the data. Secondly, utilizing smart contract technology to automatically perform data updates and backup operations ensures real-time and consistent data. For example, in the process of inputting student grades, smart contracts can automatically check the integrity of data and immediately perform multi node synchronization after successful data writing, reducing data loss caused by website crashes. Finally, the multi node nature of blockchain networks naturally possesses the ability of load balancing, which can dynamically adjust data request distribution based on system load conditions, avoid single server overload, and improve system response speed and stability.

In terms of preventing data breaches, blockchain technology also has significant advantages. Firstly, in the blockchain network, all data transmission is encrypted to ensure that the data is not intercepted or tampered with during the transmission process. Even if the website is unstable and data transmission is interrupted, the resent data remains encrypted to prevent data leakage. Secondly, blockchain can

ensure that only authorized users can access specific data through strict permission management mechanisms. For example, personal information of students and teachers can only be viewed and modified with appropriate permissions to prevent unauthorized access. Finally, the transparency of blockchain enables all operations to be monitored and audited in real-time. Management information systems can be equipped with real-time monitoring mechanisms to promptly alert and record all operation logs when abnormal operations or potential security threats are detected, facilitating post audit and traceability.

5.5. Modular Design and Microservice Architecture Enhance System Applicability and Personalized Customization Capabilities

Microservice architecture is a method of breaking down an application into a set of small, independently deployed and running services (Gangoiti et al., 2021). Each service runs in its own process and interacts through lightweight communication mechanisms, typically HTTP APIs. This architecture can significantly improve the flexibility, maintainability, and scalability of the system. Firstly, break down the various functional modules of the management information system into independent microservices. For example, student enrollment management services, course scheduling services, library management services, financial management services, etc. Each microservice is independently developed, deployed, and run to ensure high cohesion and low coupling. Secondly, lightweight communication protocols such as HTTP/REST, gRPC, etc. are used to achieve interaction between microservices. Ensure efficient and reliable communication between services, support asynchronous communication mode to improve system response speed and processing capability. Each microservice can be deployed and expanded independently, supporting automated deployment tools such as Docker and Kubernetes to achieve containerized deployment and elastic scaling of microservices. This can dynamically adjust the resource allocation of each microservice according to actual needs, improving the system's resource utilization and service capabilities. Finally, microservice architecture can effectively achieve fault isolation, and the failure of a certain service will not affect the operation of the entire system. At the same time, through service health checks and automatic recovery mechanisms, the system can quickly recover in the event of a failure, ensuring high availability of the system.

In addition, developing mobile applications and responsive web design is also an important direction. In order to meet the usage needs of students and faculty on different devices, management information systems should support access and operation on mobile devices. By developing specialized mobile applications and optimizing responsive web design systems, users can ensure a good user experience on different devices such as smartphones, tablets, and PCs. This not only improves the convenience of the system, but also promotes its widespread application and promotion.

6. Conclusion

This study proposes an optimization design plan for the management information system in the field of higher education in China and elaborates on the key steps and precautions in the implementation process. Through in-depth analysis of the current system usage status, data silos, low system integration, missing functions, and poor user experience, specific needs for improving system performance and user satisfaction have been identified in the optimization design scheme, big data technology and standardized data interfaces are first introduced to improve system integration and eliminate data silos, achieving data sharing and seamless integration between subsystems. Secondly, utilizing artificial intelligence technology to improve system functions, including in-depth academic analysis and warning, personalized education guidance, resource optimization and allocation, financial statements and budget forecasting, and teacher performance management, to meet the diverse needs of higher education management. Finally, by optimizing the user interface design and combining blockchain technology and artificial intelligence customer service systems, the system's response speed and stability can be improved, enhancing the user experience.

In summary, through the optimization design of the system and the introduction of new technologies, the application of management information systems in the field of higher education in China will be significantly improved. This can not only solve many problems in existing systems, but also improve the overall performance and user satisfaction of the system, thereby promoting the comprehensive improvement of university management level and education quality.

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