

Research on Strategies for the Management of University Teaching Laboratory in the Informatization Background

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Abstract

University teaching laboratory serves as essential platforms for disciplinary development and talent cultivation. In the background of the information age, traditional laboratory management models can no longer meet the evolving needs of laboratory development. Informatized management—characterized by efficiency, convenience, and intelligence—offers new directions for reforming laboratory management. This paper focuses on key issues in teaching laboratory management, including inadequate safety supervision systems, low resource utilization, and outdated experimental teaching models. It explores new management strategies within the context of informatization, aiming to provide references for promoting the informatization and intelligent development of laboratory management.

Keywords

Informatization background; Teaching laboratory; Laboratory management; Improvement strategies.

1. INTRODUCTION

Since the 21st century, information technology has already become an advantageous and efficient implementation in promoting educational reform, playing an important role in multiple aspects, such as breaking the limits of teaching time and space as well as expanding the breadth and depth of instructional resources. While in the informatization background, accelerating educational reform as well as systematically advancing the reconstruction of intelligent teaching, management and service systems are critical and beneficial. However, the current information technology application in the management of university teaching laboratory has remained at an initial stage. The existing practices fail to meet the rapidly evolving instructional demands and fall short of satisfying the needs of innovative experimental teaching in the new era. Therefore, enhancing the informatized management capabilities of university teaching laboratory has become an inevitable path toward improving operational efficiency and adapting to contemporary educational development trends.

2. THE CURRENT SITUATION OF INFORMATIZED MANAGEMENT IN UNIVERSITY TEACHING LABORATORY

2.1. Deficiencies in Laboratory Safety Informatization Systems

In daily teaching laboratory operations, numerous safety risks persist, including the aging and wear of instruments, improper handling during reagent transportation and storage, and the lack of standardized safety operating procedures [1]. These safety risks are difficult to control largely due to insufficient information technology support. For instance, many existing data collection systems are outdated, incapable of accurately reporting real-time operating status or

identifying subtle anomalies caused by component degradation. Subsequently, managers are unable to detect issues promptly, leading to equipment failures [2]. Additionally, due to the absence of real-time monitoring and early-warning systems, environmental factors such as fluctuations in temperature or humidity may cause reagent deterioration or leakage without timely detection, resulting in a reactive rather than preventive approach to safety management. Moreover, in the absence of standardized operational oversight mechanisms, noncompliant behaviors by users often go unnoticed, potentially accumulating into significant safety incidents that pose risks to life and health.

2.2. Low Resource Utilization and the Presence of Information Silos

The inadequate informatization of traditional management models has become a significant obstacle to the efficient utilization of laboratory resources. Without comprehensive information support systems, the scheduling and management of laboratory resources rely heavily on manual operations, leading to inefficiency, high error rates, and delays in data updates. Furthermore, processes ranging from routine equipment maintenance and calibration to reagent procurement, storage, and inventory checks depend extensively on manual recording and verification [3]. This results in delayed information updates, disorderly workflows, and low resource utilization. Additionally, the lack of unified information channels aggravates the imbalance in laboratory resource allocation. The absence of a centralized system for querying and scheduling equipment may lead to some laboratories remaining underutilized while others face excessive demands. Moreover, many universities have deployed multiple information platforms—such as large instrument reservation systems, reagent management systems, and safety assessment systems—at different stages without integration [4]. These independently developed platforms lack interoperability, forcing users to log into multiple systems and repeatedly input data. It not only increases workloads and operational complexity but also reduces overall efficiency. The resulting “information silos” hinder data integration and analysis, preventing laboratories from achieving coordinated and optimized resource management.

2.3. Outdated Experimental Teaching Models Misaligned with Informatized Instruction

Experimental teaching plays a vital role in cultivating students' comprehensive qualities, practical abilities, and innovative capacity. Although some universities have begun incorporating artificial intelligence and multimedia technologies into experimental teaching, most still predominantly rely on traditional teaching models that lack effective integration with modern informatization practices.

In conventional experimental instruction, teaching typically follows a demonstration-imitation model, with experiments mainly designed for verification [5]. Teachers explain principles and procedures based on printed manuals, and students merely follow predetermined steps. This model limits teachers' ability to monitor students' real-time progress, delays instructional feedback, as well as provides students with insufficient opportunities to build autonomy and innovation. Students often engage in superficial preparation, have limited capacity for independent problem-solving, and are prone to copying in paper-based lab reports, which hinders accurate assessment of learning outcomes. In addition, many experimental curricula have been updated slowly, failing to incorporate emerging technologies or reflect advancements in the field, thereby exacerbating the disconnection between experimental teaching and practical development for the needs of talents.

3. STRATEGIES FOR IMPROVING INFORMATIZED MANAGEMENT IN UNIVERSITY TEACHING LABORATORY

3.1. Establishing an Informatized Laboratory Safety Supervision System

Developing informatized safety systems is essential for ensuring personal safety and maintaining stable laboratory operations. Safety incidents in laboratory often arise from intertwined factors such as aging instruments, improper reagent handling, operational mistakes, and insufficient safety awareness. The underlying cause is the lack of systematic and informatized safety monitoring mechanisms.

To address this, laboratory may implement data-driven monitoring systems, equipping devices with sensors to continuously collect and analyze operational parameters. Data can be uploaded to cloud platforms for real-time tracking. When anomalies are detected, the system automatically issues alerts, enabling timely intervention and preventing equipment-related accidents. Video surveillance combined with environmental monitoring technologies can ensure the safe storage of chemical reagents by tracking environmental indicators such as temperature and humidity [6]. Automated alerts may be sent through mobile applications, enabling rapid multi-departmental responses involving security, medical, and administrative units.

Information platforms may also support safety education by offering online training courses and standardized safety assessments. Only those who pass assessments should be granted laboratory access. Virtual simulation tools can recreate typical accidents to enhance safety awareness by demonstrating the consequences of improper operations. As informatization deepens across sectors, the establishment of intelligent and systematic safety governance mechanisms will undoubtedly become a critical direction for the future development of teaching laboratory.

3.2. Advancing Informatized Management of Laboratory Resources

An informatized resource management system should integrate and coordinate laboratory data by leveraging networked digital technologies. The first step is to review existing platforms thoroughly, identify structural issues, and upgrade outdated components. Addressing resource underutilization and fragmented systems requires merging independent platforms into a unified management system that supports integrated scheduling of laboratory spaces, instruments, reagents, and safety assessments [7].

The laboratory space management module should display real-time information on space usage and availability, allowing users to make online reservations and supporting intelligent scheduling to prevent conflicts. The instrument management module should document device specifications, usage history, maintenance cycles, and real-time operating status, enabling cross-departmental sharing and avoiding both idle periods and excessive clustering of demand. Environmental sensors may further enhance automated maintenance and monitoring. The reagent management module should implement full lifecycle tracking—from procurement to disposal—using technologies such as facial recognition to ensure precise identification of users and accurate logging of reagent usage. Automated inventory updates and low-stock alerts support optimized purchasing and inventory control. The safety assessment module should dynamically link with other modules to ensure that only users who have passed safety training may reserve laboratory spaces or instruments.

By integrating existing systems into a unified platform, university can eliminate data silos, support comprehensive data sharing, enhance resource allocation efficiency, and lay a solid foundation for intelligent and refined laboratory management.

3.3. Promoting Intelligent Reform in Experimental Teaching

Traditional experimental teaching often emphasizes theoretical verification at the expense of practical and innovative skill development, leaving graduates insufficiently prepared for real-world challenges. To overcome these limitations, university should leverage modern information technologies to build an experimental teaching environment that is open, interactive, and unconstrained by time or space [8]. This shift requires improving teachers' digital competencies, including proficiency in online interaction platforms and virtual simulation tools. Regular professional development programs are therefore essential.

In line with curriculum reform objectives, university should establish intelligent experimental teaching platforms composed of resource databases, online interaction modules, and instructional feedback systems. The resource database should compile comprehensive teaching materials while incorporating emerging technologies and research developments [9]. Students may complete preparatory learning through instructional videos and online assessments before attending experiments. The online interaction module supports real-time communication and collaborative learning, allowing students to record and synchronize experimental data to the cloud. Teachers can monitor progress and provide timely corrective guidance. The feedback module enables online submission, plagiarism detection, and digital grading of lab reports. Automated analytics assist instructors in identifying learning challenges, enabling data-driven improvements and establishing a closed-loop mechanism for instructional optimization.

4. CONCLUSION

With the rapid advancement of information technology in China, new ideas have emerged for reforming the management of university teaching laboratory. Informatized management of laboratory not only enhances safety supervision and improves the utilization of laboratory resources, but also facilitates the reform of experimental teaching, enabling efficient operation of teaching laboratory and the cultivation of innovative talent. In the future, continued deepening of information technology reforms, improvement of management systems, and promotion of efficient, intelligent, and sustainable development of university teaching laboratory will be essential.

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