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ARTICLE

Construction and effect of information management platform of life science experimental teaching center

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Abstract

To give full play to lab potential and fulfill the unique feature of training talents for valuing practice and seeking innovation, an intelligent, efficient, and open information management platform has been built in the experimental teaching center of life sciences in Northwestern Polytechnical University. This study constructs an intelligent, efficient and open source information management platform. The platform is composed of five modules: comprehensive lab management system, instrument and equipment management system, reagents and consumables management system, laboratory opening platform, and laboratory teaching management system. The use of the management platform has solved the problems of miscellaneous teaching data, insufficient sharing of teaching resources, conflict of course arrangement and low lab open utilization under the traditional management mode. It also stimulates the enthusiasm and initiative of students in innovation and practice, perfects the management mechanism of making teachers play a leading role in experimental teaching, and improves the work efficiency of laboratory managers.

Keywords: experimental teaching; information management; open-sharing

As a natural science based on experiment, the construction and management of laboratory is directly related to the quality and development of subject teaching system [1]. With the continuous deepening of educational reform in universities, it is a trend to develop the teaching model aiming at cultivating students' innovative spirit and practical ability [2-3]. The establishment of the experimental teaching center has realized the efficient integration of laboratory resources, which can better exert the overall advantages and fully realize the sharing of interdisciplinary resources. However, the traditional decentralized management model is no longer sufficient to tap the potential of experimental teaching centers to support exploratory experimental teaching models, and it is imperative to build and develop scientific, efficient, and standardized laboratory management models [4-5]. The construction and

reform of the informatization management model in the experimental teaching center can greatly improve the management efficiency of the laboratory, meet the educational development needs under the new situation, and adapt to the laboratory construction requirements of continuous expansion of scale and business. Taking the Experimental Teaching Center of Northwest Polytechnic University as an example, this article constructs an information management platform, and implements a laboratory management model that focuses on students, teachers, and experimental teaching centers.

1. Analysis of the current situation of traditional management models

Traditional experimental teaching focuses on knowledge impartation, and the students mainly study some unitary and confirmatory experiments. The modern experimental teaching mode pays more attention to improving students' innovation and entrepreneurship abilities, embody the teaching philosophy of "learning by doing", and focus on improving students' innovation, cooperation, and practical abilities [6-7]. Therefore, the traditional experimental teaching management model is no longer sufficient to fully tap the potential of the experimental teaching platform and provide support for the practice of a modern teaching system. The major drawbacks are as follows: 1) Lacking informationization of experimental teaching data. A large amount of educational administration information, achievement information, and student information are held by the directly responsible person, and data sharing cannot be achieved, so the data sharing cannot be realized, which makes the arrangement of students, teachers and experimental teaching center cannot be synchronized. 2) The sharing of experimental teaching resources across courses is insufficient. There are high commonalities in the use of reagents, consumables, and instruments and equipment in life science. Failure to share among courses can easily lead to resource waste. 3) Conflicts could arise between the time and classroom arrangement of experimental courses, such as sharing laboratories for microbiology and cell biology experiments, and the simultaneous opening of molecular biology and biochemistry experiments. 4) Lacking comprehensive information-based management mechanism of experimental equipment. There may be situations when the equipment functions do not match specific requirements. 5) Management of reagents and consumables is completed by manager personnel, which is time-consuming and labor-intensive, and users cannot obtain real-time information. 6) The open utilization rate of laboratory resources is insufficient, and users cannot timely view and make appointments to complete laboratory use applications, resulting in resource waste. These problems are difficult to solve under the traditional management mode, so it is imperative to reshape the experimental teaching management system and build an "information based and open" laboratory management platform.

The Experimental Teaching Center of the School of Life of Northwest Polytechnic University has 7 professional teaching laboratories, including cell biology, biochemistry and molecular biology, microbiology and immunobiology, animal laboratory, digital microscopic interactive laboratory, organic chemistry laboratory, and innovation and entrepreneurship laboratory. The teaching team includes over 30 experimental technicians and full-time teachers, with a total of 20 experimental courses for each grade. Despite years of development and construction of the experimental teaching center, the management

of experimental teaching has achieved certain results, but under the traditional teaching management model, the effectiveness of the experimental teaching platform is not sufficient to support international first-class teaching concepts.

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2. Implementation of experiment teaching informationization

Based on the teaching characteristics of life sciences, the experimental teaching center aims to support the talent cultivation system and improve teaching quality. In response to the problems existing in traditional management models, an information management platform has been constructed, including a comprehensive laboratory management system, an instrument and equipment management system, a reagent and consumable management system, an open management platform, and an experimental teaching management system. The five major modules complement each other and realize the laboratory information management together.

2.1 Informationization of Basic Data in Experimental Teaching

The reporting of academic data in experimental teaching has been an important component of the experimental center [8]. The experimental teaching center adopts a comprehensive laboratory management system for information processing of teaching data, including laboratory organization management, achievement management, room management, experimental team management, and data reporting system. The data reporting system is directly connected to the academic affairs system, and reports are formed based on actual course information after importing the basic courses and projects. Experimental project information such as experimental content, number of participants, and class hours can be maintained in real-time by the teacher as an administrator. Students can also log in to the system before the class to view relevant information and choose courses according to their interests. Laboratory organizational management includes the basic information and management system of the laboratory. Achievement management is the information of research and educational reform projects undertaken by the center. Room management is mainly used to calculate room usage information and equipment storage, and experimental team management is used to manage the information of teaching personnel in the experimental center.

2.2 Informationization of instruments and equipment

The counting analysis of fixed asset information is also an important part of the lab's work. Due to the wide variety of instruments, some teachers can not grasp the equipment information completely when designing the innovation curriculum, so they can not write the outline or design the experiment reasonably. In order to improve this situation, the lab center uploaded information such as the time, price, brand model, and bar code of the equipment to the instrument and equipment management system. Teachers can use the account provided by the experimental center to query equipment information in real-time through the network. Management personnel can handle online approval procedures for equipment and add or delete equipment information through the management system.

2.3 Informationization of reagents and consumables

The management of reagents and consumables involves the implementation of the entire experimental teaching center curriculum system, and requires comprehensive consideration [9]. It is the material basis to guarantee the quality of experimental teaching. The experimental teacher will make a budget for the reagents and consumables used before the start of the class, but the students will spend much more on the reagents and consumables, especially on some unexpected items, because of their different proficiency levels. This caused great inconvenience to the management of the experimental center. The management of reagents and consumables involved in twenty experimental courses has always been the most tedious and arduous task of the center. In the field of life sciences, there is a common demand for reagents and consumables in the design of many experiments. Through information management of reagents and consumables, it can save the cost, ensure the stock and improve the efficiency of management. The experimental teaching center adopts a reagents consumables management system, which sets up teacher and administrator permissions respectively. Teachers can perform online inventory query, requisition, purchase, and other operations through the system. Administrators can view the total remaining inventory of all teachers after requisition, facilitating timely replenishment to meet unplanned usage needs. At the same time, administrators can perform operations such as reagents warehousing for Inbound and outbound operations, procurement approval, historical record inquiry, account invitation and authority grant

2.4 Open management of experimental center

Open laboratory management allows students to arrange their time reasonably according to the requirements and progress of the experiment, and cultivate students' initiative exploration, independent thinking and positive scientific spirit [10]. Therefore, the lab center has established an open management platform to meet the needs of students' extracurricular time for the use of the laboratory, which includes the open management of laboratory and the open sharing system of equipment. The opening management of the laboratory includes two parts: Teacher's business and center's business. Teachers can log in to the system to check the occupancy and seating capacity of each class of the laboratory within a week, and apply for the laboratory that needs to be used; Administrators can view the open course schedule of the laboratory, manage the use of the laboratory and review room requirements. At the

same time, in order to achieve 24-hour opening of the laboratory and ensure laboratory security, the experimental center has integrated the laboratory opening system with the access control system and network monitoring system. Users register in the access control system, and the administrator will authorize them to use the laboratory. They can also control the access control of the laboratory through wireless networks. High definition cameras have been installed in each laboratory to monitor the laboratory's activities in real-time.

The open sharing of instruments and equipment relies on the instrument and equipment sharing information system of the Institute of Science and Technology. Users can log in to the system to view device parameters, billing information, and make instrument reservation. Administrators can add and delete shared devices, set the charging standards, approve reservation applications, and calculate machine hours.

2.5 Management of experimental teaching

The core business of undergraduate teaching laboratories is to undertake experimental teaching, so the experimental center adopts an experimental teaching management system manage teaching tasks. The system includes three modules: teacher's business, center's business, and operation monitoring. The teacher's business includes demand management, individual schedule management, schedule query, and suspension application. The center is responsible for syllabus review, room occupancy enquiries and project scheduling, etc. The main function of the monitoring module is to monitor course information, such as the schedule of the day, demand filling monitoring and schedule progress monitoring.

3. Achievements in the construction of information management platform

The construction of the information management platform for the experimental teaching center has created an intelligent, efficient, and open environment for life science experimental teaching, effectively promoted the rational use of experimental teaching resources and the maximization of benefits [11-12]. The collaborative use of various systems on the platform has greatly improved the role of the experimental teaching center in the optimization of the experimental teaching system with a 100% increase on the laboratory opening rate and a 30%,increase on equipment utilization rate. It also supported six new courses. The usage of the system is helpful to encourage the students' enthusiasm and initiative in innovation and practice, improve the management mechanism of teachers' leading role in experimental teaching, and increase internal motivation for staff to focus on laboratory construction work.

3.1 Improved student training effectiveness

The information management of laboratories provides effective support for cultivating students' practical skills and innovative spirit [13]. Through the information management system, students can master the course information before class, be informed of the open use of the laboratory after class and arrange their own experimental progress according to their extracurricular time and laboratory occupancy. The information-based management mode has transformed the experimental center from a closed to an open one. Students apply for the use of laboratories and large and valuable instruments and equipment through

the internet. The experimental center arranges responsible teachers to train students on the use of equipment. Students demonstrate a high level of initiative and enthusiasm for the experimental courses, from "asking me to do" to "I want to do". Taking " Biology open innovation experiment" as an example, the course only has four teaching hours per week, but the information management system shows that students' laboratory usage time is much longer than class time. And some students' extracurricular usage time is as long as 12 class hours per week. The information-based management model enables students to make rational use of their time, practice their interests and hobbies and actively innovate and practice.

3.2 The entire teacher-leading process

After the implementation of information management in the experimental center, teachers can adjust courses and change relevant information in a timely manner. They can choose the opening time and schedule classroom usage time according to needs, and arrange teaching tasks reasonably based on equipment usage information. It avoids the queuing phenomenon caused by different courses using a certain device at the same time in the past. At the same time, the information management of the experimental center enables teachers to grasp the overall information of the center in real-time, rather than limited to course content. It provides a good practical platform for teachers to guide interdisciplinary and integrated innovation and entrepreneurship projects and college student competitions.

3.3 Improving the management efficiency of center staff

The data of educational administration involves teachers, students, funds and so on. In the past, the collection of data was directly requested by the center's laboratory personnel by contacting relevant responsible persons, which resulted in long feedback time and data errors. After the adoption of an information management system, the course project information was already entered by the teacher at the beginning of the class and can be directly exported from the system. The teaching achievements and student situation can be directly entered by the teaching secretary with authorization, and the basic information of the experimental center is entered by the experimental technicians. Finally, a unified report is generated by the system, greatly improving the accuracy and work efficiency of the data.

The use of information management systems greatly improves the efficiency of management personnel in controlling experimental teaching centers [14]. The laboratory comprehensive management system liberates the staff of the experimental teaching center from the tedious work of data collection and report filling, and realizes the intelligent management of data, so that they can put more energy into the construction of experimental teaching system. The running and using of reagent and consumable management system and open management platform realizes the automation of laboratory daily management, liberates a large occupation of human resources, and improves the overall running efficiency of the center.

4. Conclusion

The experimental teaching center is the main platform for carrying out practical education for students, aiming at enhancing students' innovation, cooperation, and practical abilities. The rapid development of information technology has led to diverse changes in experimental teaching models, teaching methods, and teaching content. Therefore, the construction of information-based platform management mode has become an inevitable trend to adapt to the new era of experimental teaching. The establishment of the information-based management platform of the life science experimental teaching center has effectively stimulated stimulated students' initiative to study and practice, improved the teaching quality control of teachers and the working efficiency of experimental management managers, and realized the scientific, information-based and efficient laboratory management.

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