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Construction and Innovation of Management Mode of Laboratory in Regional and Local Universities

Guofang Liu [1, *]

[1] School of Mechanical&Vehicle Engineering, Linyi University, Linyi, China;

* liuguofang@lyu.edu.cn

Abstract. University laboratory is an important base for training students' innovative practice ability and teachers' scientific and technological innovation, and is an important part of university. Traditional laboratory management methods have been unable to adapt to modern practical teaching and scientific and technological innovation. Based on the comprehensive analysis of laboratory management in local colleges and universities and the actual situation of existing laboratories, a comprehensive laboratory management system was developed, which consisted of six functional modules: large-scale equipment sharing platform, instrument and equipment maintenance system, experimental consumables management system, laboratory and practice teaching integrated service platform and laboratory safety management and service platform. The system fully integrates and displays the laboratory teaching resources, realizes the open self-management mode, provides the convenience of experimental teaching, and effectively improves the efficiency and management level of the laboratory.

Keywords: laboratory management; Module design; laboratory platform.

1. Introduction

University laboratory is an important place of university education and teaching, and is an important part of high-quality talent training and national innovation system. Laboratory construction not only reflects the level of scientific research and education of a university, but also reflects the innovative strength of the school to a certain extent.

Linyi University is a comprehensive university of economics, law, education, literature, history, science, engineering, agriculture, medicine, management, art and other disciplines. It started undergraduate education in 1998, was renamed Linyi University by the Ministry of Education in 2010, and was approved as a master's degree-granting institution in 2018. The development of multi-disciplinary laboratories varies, and the management is very difficult, which has always been one of the difficulties in the development of schools. At the beginning of the undergraduate period in the 1990s, the university vigorously developed the construction of laboratories and carried out the construction of key laboratories. In order to meet the actual needs at that time, the university established a laboratory management center, in which key scientific research laboratories and important instruments and equipment were under the unified management of the experimental center, and general professional teaching laboratories were under the management of the department. Under the condition of providing key laboratories and important instruments and equipment, the school has introduced a large number of high-level talents, making the school have rapid development. In the new century, a large number of high-level talents in various disciplines have joined, and the original laboratory management model has been unable to meet the needs of the development of the school. The experimental management center of the school has assigned key laboratories and important instruments to the department, fully mobilizing the enthusiasm of the laboratory construction of the department, making the laboratory construction have considerable construction and development. In recent years, with the rapid increase of interdisciplinary experimental teaching in different departments, it is urgent for schools to integrate resources, improve the utilization rate of experimental equipment, and serve the whole school. In this case, how to use information technology to improve the management level and further meet the growing new needs of practical teaching while the number of existing laboratory managers remains unchanged has become an important issue for the development of experimental management.

Therefore, the school focuses on the construction of laboratory management system, which provides a solid foundation for the development of the school.

2. Laboratory management status

There are some problems in the operation of the traditional management mode of the laboratory.

2.1 Experimental resources are scattered and data cannot be shared

Table 1 lists some course resources and virtual simulation experiment projects of the Center. Most course videos and supporting experiment resources of the Center are distributed on multiple platforms such as Chinese university MOOC platform, Xuetang Online, Trustie and EduCoder. The resource platform of each course records different data fields, and the data between different resource platforms cannot be automatically summarized to form big data for analysis.

Table 1. Resources of some courses and virtual simulation experiment projects in the center

No.	Course / Project	Course Video Platform	Supporting experimental platform
1	university computer foundation	China University MOOC	EduCoder
2	University of computing	EduCoder	EduCoder
3	Computer principles	China University MOOC	Under the line
4	Data Structure and Algorithm	Under the line	Under the line
5	Compiler principle	China University MOOC	Under the line
6	Computer programming	School online	EduCoder
7	Computer network	Love course	EduCoder
8	Big Data Technology Capability	No	EduCoder
9	Intelligent Unmanned Vehicle Path Finding Virtual Simulation Experiment	No	Under the line
10	von Neumann Computer Virtual Simulation Experiment	No	Experimental spaces

2.2 Manual operation, low management efficiency

The old portal website shows the information of the center, class schedule, equipment, experimental teaching courseware, rules and regulations, etc. Teachers and students can download the relevant forms from the old portal, apply for the machine and equipment by email, and finally the application form is reviewed and processed manually by the experimental manager. On the basis of ensuring normal experimental teaching tasks, the center is open to students at 7 ×14 hours every week, and full-time experimental management personnel are responsible for the daily opening and maintenance of the experimental center. According to 40 teaching weeks per year, the opening time

of the laboratory can reach 1.1 million machine hours per year. Although it can meet the needs of experimental teaching in schools to the maximum extent, the traditional reservation method cannot provide timely feedback information, and the workload is large and error-prone, and it is necessary to manually count the opening of the laboratory.

2.3 Personnel information data is independent and not updated in time

The old access control system is arranged on an independent server on the Intranet, and it needs to apply for new student information from the school every year and manually import the personnel database. There are some problems such as complicated management process, unsynchronized personnel information and untimely update.

3. Development of laboratory management systems in other universities

In recent years, many reforms and explorations have been made in the research and application of laboratory integrated management system in domestic universities. For example, the comprehensive laboratory management system of Northeast Agricultural University, which integrates basic management, construction management, open management, instrument and safety management, realizes the unified process management of laboratory construction, safety and instruments of the whole school [1]. Southwest University of Science and Technology and other universities try to build a management system from the perspective of big data to improve management level [2- 4]. Chongqing University of Technology and other universities introduced the construction of intelligent management system based on Internet of Things technology [5- 10]. Jimei University and other universities introduced the design and implementation of a comprehensive laboratory management system based on cloud computing technology [11- 13]. School of Physics and Electronic Engineering of Hanshan Normal University designed and implemented an open laboratory reservation system based on QR code [13]. Although the integration of laboratory management system and new technology in universities is effective, there are still some problems such as low utilization rate of some functions of the management system, too complicated process and inconvenient operation for laboratory managers.

4. System design and implementation

The design of laboratory integrated management system should follow the principle of "student-oriented, teacher-oriented", that is: Laboratory construction and resource allocation should fully respect the opinions of grassroots users. Through a smooth and transparent information platform, the main body of laboratory managers should be transformed into the main body of experimental teachers and students, and a direct and equal connection mechanism between laboratory managers and users should be established to meet the actual needs of teaching.

4.1 Comprehensive service platform for laboratory and practical teaching

The module implements a two-level management structure. The director of the experimental center is in charge of all laboratories, and can maintain basic information such as laboratory number, name, laboratory leader and laboratory location, and can assign laboratory administrators to manage specific affairs. After the director of the laboratory designates the person in charge of the laboratory, the person in charge can continue to add other information about the laboratory under his/her jurisdiction: such as laboratory area, layout, laboratory type, laboratory function, laboratory funding and other detailed information.

4.2 Integrated service platform module

The functions of the laboratory and practice teaching integrated service platform module cover all aspects of experimental teaching, namely the entire teaching process such as experiment

arrangement, attendance, experiment report, experiment correction and score management. The teaching process is optimized by means of information technology to ensure the quality and order of experimental teaching.

Before the experiment, teachers can maintain the experiment library, arrange the experiment and upload the experiment resources according to the teaching administration course and the beginning of the class; In the experiment, the intelligent terminal is used for attendance management to monitor whether the students are absent. After the experiment, I can view the students' experiment report online, correct the experiment results, export the experiment report, and make statistics and release the experiment results.

Before the experiment, students can check the relevant resources of the experiment, and preview the experiment according to the requirements of the teacher; After the experiment is completed, the experimental report can be submitted online.

The whole process of experimental teaching management module manages the whole process of experimental teaching; When students submit the experiment report, the system will automatically correct the objective questions intelligently, which greatly reduces the workload of teachers, and teachers can also manually correct; It supports the combination of intelligent terminal to realize students' experimental attendance, and automatically generates students' attendance records, which is convenient for teachers to manage students' attendance.

4.3 Large-scale equipment sharing platform

The large equipment sharing platform module and intelligent terminal realize the open self-management mode. Teachers and students can make laboratory appointments through mobile phones, computers, tablets and other terminals, and the two-dimensional code information verified by the school after approval can be used in the classroom. According to different user permissions, there are two modes of open appointment lab: appointment classroom and appointment workstation. The module can display the situation of laboratory equipment in real time, and teachers and students can complete the approval process online according to their needs, which greatly simplifies the process and improves the utilization rate of equipment. In addition to the above reservation operation, the system will carry out statistics and graphical display of the reservation information, including the laboratory utilization rate, station utilization rate, and instrument utilization rate, so as to facilitate the management and decision-making of the laboratory administrator.

4.4 Experimental consumables management system

Because the school has independent instruments and equipment and financial management platform, this module only provides information import and basic functions of adding, deleting, correcting and checking, so as to facilitate the daily management statistics of laboratory managers.

5. Results

At present, the laboratory comprehensive management system has been officially launched, and students, teachers, administrators and other types of campus users can log in and use the website or wechat public account. The system uses the unified authentication account of the school to log in, improve the security of the account, but also convenient for users to use. All kinds of news of the center are released timely through the portal website to facilitate teachers and students to know the progress of the center's work. The new portal is convenient for teachers and students to view the actual layout and equipment information of the laboratory. The open appointment management system greatly reduces the workload of the administrator and improves the utilization rate of the laboratory. The integrated service platform module of laboratory and practice teaching realizes the record and management of the whole experiment process, and provides quantitative analysis data for experimental teaching. At the same time, the visual data analysis function provided by the

system displays the laboratory operation data in real time, which provides decision basis for administrators and leaders.

6. Summary

The laboratory information management system is designed and implemented based on the actual situation of the university, providing the process management of experimental teaching. Intelligent terminal technology is used to realize the open self-service reservation management mode relying on the campus network, simplifying the approval process of some modules. This system promotes the innovation of laboratory management by means of information technology, creates a breakthrough in the space and time of traditional laboratory resources, and builds an ecosystem of laboratory resources and functions that are extensible, open, dynamic, quantifiable and relevant.

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