Construction of Laboratory Refined Management in Local Applied University

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Abstract. The refined management of laboratory in local applied university is conducive to the formation of mode to innovative talent training and the improvement the ability to innovate. To ensure the efficient operations of laboratory in local applied university, in this paper we put forward to s new construction method of laboratory refined management in local applied university on the basis of analyzing the current actual situation of laboratory managements. Finally, taking the Computer laboratory of School of Electrical and Electronic Engineering in Shanghai University of Engineering and Technology as an example, the refined management case of laboratory in local applied university is constructed in terms of developing and designing of the refined laboratory management information system (MIS), and future works on the following refined managements of laboratory in local applied university was presented. It has a certain impact on promoting the management efficiency of local applied university and the service ability of the society.

Keywords: Local applied university · Construction · Refined management · Laboratory · Management information system (MIS)

1 Introduction

Local applied university is an important part of China's higher education. In accordance with the economic and social development and education reform under the new situation, the major decisions that guiding and promoting some undergraduate universities transformed into applied functions have made and implemented [1]. The State and local governments have continuous deepen the education and teaching reform and improve the running conditions. Meanwhile, to strengthen and improve the practical teaching ability of local applied university, the national development and reform commission (NDRC) and the Ministry of Education and other departments have proposed continuously the implementation of education modernization projects for local applied university [2]. The State will take the lead in supporting 100 universities in

Q. Li et al. (Eds.): BROADNETS 2019, LNICST 303, pp. 275–284, 2019.
https://doi.org/10.1007/978-3-030-36442-7_18

strengthening the construction of experimental training platforms and experimental bases so as to improve the quality of higher education by project demonstration of new modes of personnel training.

Correspondingly, with the rapid increase of State and local governments' economic investment, the construction of Shanghai science and technology innovation center has intensive demand for refined management for instruments and equipment and open sharing. However, due to various factors in the current laboratory construction, the laboratory management cannot serve the economic and social development and personnel training of local applied university [3, 4]. As an important institution of scientific research and teaching in university, laboratory plays an important role in the daily operation of universities and social services [5]. How to carry on refined management has become the key of improving our laboratory management level and the use efficiency of instrument and equipment, and further realizing its open sharing to the society and win-win situation of teaching and research.

Based on analyzing for the laboratory management in local applied university, we first summary the existing problems of laboratory management and point out the suggestions and countermeasures. And then, taking the Computer laboratory of School of Electronic and Electrical Engineering in Shanghai University of Engineering Science as an example, the refined laboratory management has been constructed and implemented by developing and designing the laboratory management information system (MIS) in this paper. It has great significance to improve the use efficiency of laboratory equipment and teaching and scientific research level, and to serve the laboratory information construction of local applied university. In this paper we present a practical laboratory MIS of Computer laboratory of School of Electronic and Electrical Engineering in Shanghai University of Engineering Science, it is possible to improve the laboratory management level and the use efficiency and open sharing of instrument and equipment to some extent.

The rest of the paper is constructed as follows: Sect. 2 explains the related work. Section 3 presents the refined management approach in university laboratory. Section 4 devotes the refined management experiments of laboratory MIS in local applied universities. Section 5 discusses the shortcomings and deficiencies of this work. Finally, our conclusions and future work are drawn in Sect. 6.

2 Related Work

2.1 Current Status of Laboratory Management

Limited by the financial input in the early stage, the funds available for laboratory construction in local applied university are relatively less, especially in laboratory management hardware, which is obviously different from those universities affiliated to the Ministry of Education [6–8]. Traditionally, the management of laboratory is mainly registered and recorded by manual operation, and then generates reports and other output results. These traditional manual methods are not only time-consuming and laborious, easy to produce errors, and the effect is not ideal in practical use. In recent years, the rapid popularity of the Internet has become the important grasp of information

construction and refined management for laboratory, and currently it basically covers almost all universities [9, 10]. In addition, on the basis of hardware resources, the refined management of the laboratory is mainly accompanied by corresponding software. At present, many local applied universities have initially established corresponding laboratory MIS by various ways [11]. However, subject to the conditions of local applied university, it has different management functions and development levels, and there are various differences in specific use. According to the statistical analysis for the current mainstream university laboratory, most of those have routine operation, maintenance and laboratory safety management, and the users include student, teacher, management stewardship, departments in charge of the leadership, etc.

At present, a large number of hardware and software products compatible with laboratory management on the market are usually expensive. Laboratory construction and management have long been of little contribution to teaching and scientific research [12]. Faced with limited funds, many universities prefer to purchase scientific research-related instruments and equipment, rather than spend money on laboratory management. As a result, the laboratory refined management is mostly in words, and the actual implementation is not really promoted and implemented. And it seriously restricts the improvement of laboratory management level and the effect of instrument open sharing.

As an important part of laboratory refined management in local applied university, experimental teaching and talent cultivation are far from keeping pace with the times. In recent years, with the advancement of education informatization, a series of new teaching forms have been emerging, such as Mooc, Micro class, Boutique class, Flip class and Virtual reality simulation, etc. [13, 14]. However, these new technologies and means have almost never been involved in fact, and most experimental teachers are limited by age and scope of knowledge, it is difficult to effectively and skillfully apply these new media means [15, 16].

2.2 Problems of Laboratory Management in Local Applied University

The function is incomplete and missing overall planning. At present, the laboratory management of the most universities is still stays in the primary stage, and generally lacks the laboratory website, and the content of laboratory management is relatively simple. And there is no effective integration for different functions. On the one hand, for the network construction in the laboratory informatization, the laboratory adopts network and security-related equipment eliminated by other scientific research departments. There is relatively little newly purchased equipment, and many functions cannot be effectively developed and utilized. On the other hand, for laboratory management software, many universities design primary laboratory management software by themselves to save funds. These management software not only function is simple, the system is not perfect, comprehensive, and the security is not effectively guaranteed, easy to cause laboratory information leakage and security risks. It is not conducive to the implementation and rapid progress of laboratory refined management.

The management mode is unreasonable. The management mechanism is backward, and the management mode is unreasonable is one of the most important factors. At present, many universities still adopt the traditional university-college-department three-level management mode. Since the management system was initially set up and

divided in terms of majors, the rise of cross-disciplines was not considered. To some extent, there are some problems in the practical use, such as repeated acquisition of equipment, overlapping of laboratory management functions and low efficiency, etc. And what's more, the laboratory usually adopts the single-machine management mode, which is difficult to adapt to the needs of laboratory personnel training in local applied university, and it is not conducive to the construction of comprehensive information MIS platform by cloud computing and other new technologies.

Shortage of openness and uniform standards. At present, the teaching and management of laboratory in many colleges and universities are mainly closed, the experiments are usually carried out in classes, and it is rarely open to students all day. On the one hand, the lack of effective communication and sharing between different types of laboratories and reduces the overall management and use efficiency of laboratories, which is not conducive to serve the society by local applied university. On the other hand, there is a lack of unified standards for the construction of laboratory MIS among different laboratories, which makes the management system established difficult to connect with each other. The laboratory management of local applied university did not consider the unified standards of openness under the background of information construction.

3 Methods

3.1 Updating the Concept of Laboratory Management

In the practical use, we should change the old traditional concept of emphasizing scientific research and neglecting experiment, strengthen the new concept of opening and refined management of laboratory construction, and further establish a brand-new open experimental environment. And then it significantly improves the management and use efficiency of the laboratory in local applied university. In an open and centralized experimental environment, by the centralized management and open use of valuable laboratory instruments and equipment, it breaks the shackles of existing equipment sharing service mode and improves the degree of open sharing and service of local application-oriented university laboratories. In the newly management mode, it is necessary to break the traditional three-level horizontal management mode between colleges and departments, learn from the current laboratory management mode of foreign universities and research institutes, design laboratory complex with specific application scenarios as the unit, and establish the experimental platform environment for centralized management and use. In addition, for the work of laboratory management, attention should be paid to the connection and coordination among different applications so as to avoid repeated setting of projects and repeated procurement of instruments and equipment, and to finally improve the level and efficiency of laboratory management.

3.2 Promoting the Construction of Experimental Technical Team

An experiment team with complete structure and reasonable collocation is the fundamental guarantee to realize refined management and efficient operation of university laboratories. It is necessary to increase the professional training of experimental

technical and managerial personnel to improve the professional level and overall quality of the experimental technical team. Detailed and feasible rules and regulations for laboratory operation and assessment should be established and improved, and the post responsibilities of new experimental technical team are revised and formulated according to the actual situation, meanwhile, laboratory managers are encouraged to actively participate in specific scientific research projects, and stimulated the innovation ability of experimental technology. In addition, the related department should take effective measures, actively try to hire experimental series leading talents from well-known universities or research institutes, and attract high-quality experimental talents to participate in the experimental technical team of universities by setting up a number of specific post plans, so as to drive the rapid improvement of the overall level of laboratory technology and management. At the same time, local applied university laboratories should be good at breaking the routine according to their own characteristics and practical needs, innovating the regulations on the professional title evaluation of experimental series, setting up the reward and evaluation measures for experimental series, improving the enthusiasm and enthusiasm of experimental personnel, and further broadening the professional title promotion channel for experimental personnel. It has great significance to the long-term stable development of the laboratory and to improve the level of laboratory fine management.

3.3 Establishing the Portal Website and Construction Standard

The local applied universities should strengthen vigorously the investment in laboratory construction, actively promote laboratory informatization, realize fine management of laboratory, change the previous manual registration management mode of laboratory, and effectively overcome the current overlapping functions, unclear division of labor and horizontal management mode of laboratory. By the establishment of the laboratory portal website, the laboratory teaching, scientific research, management, maintenance and other work can be integrated into one. It can not only clearly understand and complete the refined management of the overall laboratory daily operation and online performance assessment, but also realize the functions of experimental teaching and open sharing of valuable instruments, which greatly saves the development cost and improves the ability of local applied universities to cultivate talents and serve the society innovation. In addition, for portal construction based on a multimedia laboratory of refined management, it needs the related department planning design and functions in advance, establish function module that both suitable for local applied college laboratory itself characteristic and has a certain standard of interoperability standards, and finally improve the efficiency and scalability of the laboratory of refined management.

4 Experimentation

In this section we take the development and design of Computer laboratory MIS of School of Electronic and Electrical Engineering in Shanghai University of Engineering Science as an example, and try to carry out preliminary construction and implementation of laboratory refined management software.

4.1 Design Objective

The design objective is to establish a laboratory refined and comprehensive management platform, including experimental teaching, laboratory inquiry and appointment, equipment inquiry and appointment, laboratory management, data export and summary, report generation and other functions. It can reduce the complexity and labor intensity of daily laboratory management, improve the level and efficiency of laboratory management, and meet the needs of local application-oriented university laboratory innovation personnel training mode and serving the society by means of multimedia means.

4.2 Implementation

Platform model architecture. The laboratory refined MIS platform is composed of graphical interface and developed by using SQL Server database, B/S three-layer architecture and object-oriented technology in the Visual Studio environment. It basically realizes the overall refined management process of laboratory or instrument reservation, experimental teaching and daily management, maintenance, data export, report generation and so on. Users include administrators, students, and teachers. Software platform features complete, clear and simple, friendly interface, with strong portability, security and data statistics summary ability.

According to the demand analysis and the overall architecture model of the system platform, the constructed MIS software platform consists of three main functional modules, including administrator, teacher and student. Each kind of management module has corresponding function authority and usage instruction, respectively. Figure 1 shows the detailed entity relation (ER) diagram designed for the database of laboratory management system platform.

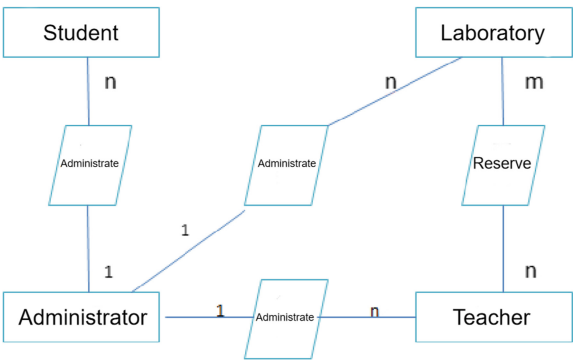

Fig. 1. ER diagram of laboratory refined MIS platform.

As shown in Fig. 1, administrators and students, administrators and teachers, and administrators and laboratories are one-to-many relations, as well as teachers and laboratories are many-to-many relations.

Platform function realization and description. This system adopts the current mainstream framework and divides the interface into upper and lower areas. Meanwhile, the following area is divided into left menu and right content. The left menu shows the permissions and functions of the current user's role, and the right content area shows the contents during operation.

The main interface of refined MIS is shown in Fig. 2. When the user submits the login information, the systems first check whether the user's username and password are correct. Teachers are not able to access the administrator interface. On the opposite, students are not able to access the administrator interface, too. If the user enters the information incorrectly, the system will pop up an error message warning the user.

Fig. 2. Main interface laboratory refined MIS platform.

The main interface of the student and teacher function is shown in Fig. 3. As shown in Fig. 3, students can modify and improve their personal information, and make an appointment for the use of the required laboratory and equipment and make an appointment record inquiry.

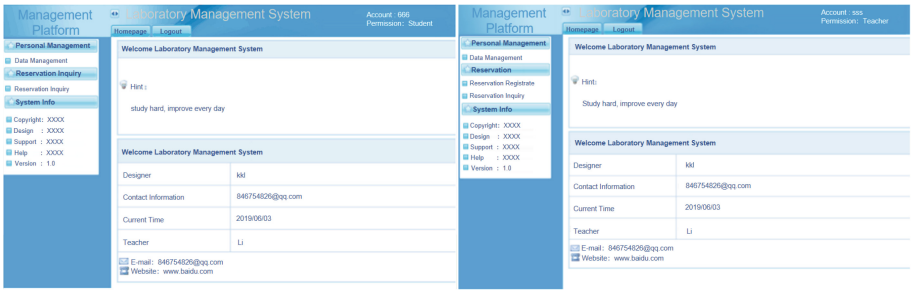

Fig. 3. Main interface of the student (a) and teacher (b).

Although the functions of teachers are similar to those of students, the differences in authority have been taken into account at the beginning of the design. Students can only reserve some instruments and equipment and special laboratories for undergraduate experimental teaching, while teachers can reserve all instruments and equipment and laboratories.

The main interface of the administrator function is shown in Fig. 4. The administrator has the full authority of this system platform.

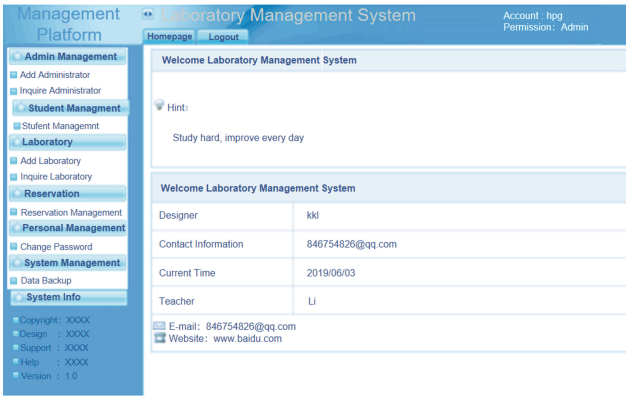

Fig. 4. Main interface of the administrator function.

System administrators are divided into general administrators and super administrators. Super administrator can add roles to realize the allocation and management of permissions of different users (ordinary administrators, teachers and students), as well as the summary, statistics and output report generation of each type of reservation and registration. It can provide data support for annual laboratory management and equipment usage.

5 Discussions

The Computer laboratory of the School of Electronic and Electrical Engineering in Shanghai University of Engineering Science has made a preliminary exploration on the refined management of the laboratory, and some consensus and achievements have been obtained on the relationship between laboratory fine management and information construction. However, considering the current mode of scientific innovation construction and talent cultivation of local applied universities, the following four problems are worth further discussions:

Laboratory refined management should fully consider the open and shared inquiry, appointment and performance assessment of existing valuable instruments and equipment in universities. The constructed MIS experimental management system is

only preliminary about the sharing of laboratory instruments and equipment, without too much reference to specific sharing service mechanism and functions.

The laboratory refined management needs to be the university "a board of chess", which should be included in the laboratory management of the whole university and planned, coordinated and promoted the refined management of the laboratory from top to bottom. It should further refinement and integration of the same or similar laboratory management functions.

With the emerging of the multimedia technology means, the laboratory refined management should not only rely on Internet technology, but also rely more on new multimedia technology. For example, two-dimension code, WeChat, microblog, etc. Experimental teaching and laboratory refined management can be achieved on PC and mobile terminals by cloud platform and Internet of things (IoT) technology; it greatly enriched the technical means and content of laboratory refined management.

Laboratory refined management not only involves the contents of experimental teaching, laboratory management, instrument and equipment management and maintenance, but also involves how to evaluate the quality of these services. By linking it with department and individual performance appraisal, keeping crisis consciousness at all times, and fully mobilizes the enthusiasm of laboratory staff.

6 Conclusions and Future Work

As an important part of local applied university, the personnel allocation, management and service level of laboratory have become one of the key factors to cultivate innovative talents in colleges and universities and serve the social innovation. The popularity of the Internet and the rise of new media have provided the possibility of laboratory refined management. In view of many factors affecting the construction of laboratory information and refined management, local applied university should change the current stereotypes emphasizing scientific research and teaching and neglecting laboratory, update the concept of laboratory management, vigorously promote the construction of experimental technical team, and explore the unified standard of refined management of laboratory in local applied universities. It will accelerate the process of laboratory fine management and construction, and finally realizing the win-win situation of personnel training and laboratory refined management via the construction of newly laboratory refined MIS platform. The result shows that it is useful to improve the use efficiency of management level of laboratory in local applied university. In addition, laboratory refined management is a systematic engineering, involving not only network, multimedia and other technical means, but also laboratory management and technical personnel. Future work includes compare and evaluate different construction approaches and platforms of refined management with other management modes.

Acknowledgement. The work was supported by the Science and Technology Development Foundation of Shanghai in China under Grant No. 19142201600.

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