

Operation and Management on Open Laboratory for Creative Talents Training

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Abstract: Laboratory is an important classroom for imparting students' knowledge and cultivating their comprehensive quality. It is an important base for students to apply theoretical knowledge to practical process. It is also an important place for cultivating students' innovative ability and scientific research interest [1]. In order to implement its function, reasonable operating mechanism and scientific managing modes are both necessary. This paper mainly discusses the connotation and necessity of open laboratory, explores its operation mechanism and management, and provides some examples of operation and teaching mode.

1. Introduction

Combined with the international development trend of the education and the requirement of higher education, universities laboratory plays a key role in innovative talent cultivation. Laboratory is not only the significant basement for students to carry out scientific research and practical activities, but also the cradle of cultivating innovative talents, and the key to the modern universities [2].

Open laboratory is one of the best effective ways to promote teaching reform and laboratory construction, and improve students' interest in their majors. Besides, it is an important guarantee for students to improve their practical innovation ability, which is conducive to the cultivation of students' vocational skills and basic qualities. It is the goal of personnel training requirements. Furthermore, it can also improve the utilization ratio of resources of universities.

2. The Meaning of Open Laboratory

First of all, for students, open laboratories are conducive to cultivating their scientific and professional interests, which drive them to stimulate innovative thinking. Open laboratories provide students with more opportunities, more resources, along with the environment and conditions for bold attempts and practices, which are conducive to cultivating their scientific interests. What's more, due to their different abilities, interests and needs for lab-related resources, it is supposed to pose certain challenges to the open laboratory. In this way, it can meet the diversified needs of them, offer them the space for independent learning, and encourage them to do active research and exploration [3].

Meanwhile, open laboratory provides necessary conditions for further teaching reformation, like experimental and practical teaching reform, in particular. It provides students with more research topics to participate in, more hands-on opportunities, and helps improve their practical ability. Sometimes, teachers are limited by relevant venues, equipment and other resources, when they have new ideas and seek new breakthroughs in talent training and teaching methods, which is detrimental to talent training and the improvement of teaching ability. However, open lab helps provide the way and necessary guarantee for teachers to reform, explore the experiment and practice teaching.

Last but not least, experimental equipment is core resource of laboratory, and also a necessary condition for scientific research and talent training. At present, through the investment and construction of the country, region and school, the laboratories of universities are provided with

advanced scientific research equipment, and even world-class ones. Open laboratory can make full use of the resources in lab, avoid them in the state of unmanned use, and improve the utilization rate.

3. The Operation and Management of Open Laboratory

3.1 Operation

The operation of open laboratory should not only follow the principle of teaching first, education innovation, resource sharing and social construction, but also adopt the operation mechanism of multi-level and multi-mode to promote talent cultivation and laboratory construction.

According to students' level and needs, professional background and teaching objectives, the operation of open laboratory can be divided into several levels. For junior undergraduates, open laboratory provides a platform for them to understand relevant knowledge system and professional skills. For seniors, it provides them with necessary resources for deeper understanding and better skills, as well as relevant practical and innovative activities. For the teaching and cultivation of postgraduates, it provides them with experimental resources related to scientific research.

On the basis of different use objectives and requirements, there are three operations of open lab which are “teaching mode”, “innovation mode” and “school-enterprise joint mode”, as shown in Fig 1 [4]. The teaching mode is mainly aimed at the traditional teaching way to meet the requirements of the curriculum system and student training objectives. The teacher is the leader and responsible for the operation and management of the laboratory. As for the innovation mode, it needs students' participation in independent scientific and technological innovation practice. It gives students and teachers the right to make appointment and use labs independently. As regards the school-enterprise joint mode, which pays close attention to enterprises participating in students' practical innovation activities, it offers students the latest industry trend, guides them to improve practical skills, and establishes joint laboratories. At the same time, open laboratory can provide enterprises with paid use of experimental equipment, which can serve the society on the basis of talent training on one hand, and open up new ways for the source of laboratory construction funds on the other hand.

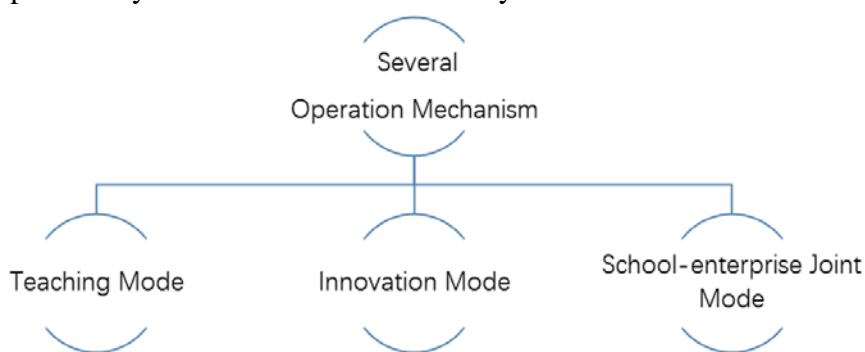


Figure 1. Several operation mechanism of open labs

3.2 Management

Scientific and effective laboratory management mode is necessary to ensure the normal operation of open laboratories. The management mode of it based on several systems: “cloud-base storage system”, “access-control system”, “authorization system”, “supervision system” and “resource query system”, which helps realize informatization, being controllable and transparent [4].

According to the regulation, students may participate in the management. They are responsible for the laboratory environment, daily inspection and maintenance of experiment equipment. Students who participate in laboratory management need to pass “student application”, “teacher approval”, “pre-job training”, etc., so as to ensure that students have the access, provide certain guidance and help them in the process of practical innovation activities.

Although the students take part in the management, related teachers still need to monitor the daily work of open laboratory, like checking the usage and maintenance of laboratory equipment, so that

damaged and missing parts can be handled in time. Meanwhile, teachers should supervise the safe operation of students, especially when involve strong electricity and dangerous chemicals.

The use of open lab and related resources adopts the resource query system. Teachers and students can check the free time of laboratories and equipment on the management platform by themselves, and make the appointment according to their own schedule and needs.

4. Applications

Nowadays, the unchangeable teaching mode can no longer keep up with the pace of the timing, and the abilities of the students cultivated cannot meet the needs of the society for talents. As a result, universities constantly put forward the need to deepen teaching reform, especially for the experimental and practical teaching mode. Below are 2 examples of the new teaching mode and operation mode of open lab.

4.1 MOOC

MOOC (Massive Open Online Courses), were first proposed by Canadian scholars in 2008 in an online course called *connectionism and connected knowledge* [5]. In 2013, MOOC entered China,. Nowadays, Well-known universities in China have been involved in MOOC one after another, with education online platforms established, such as *XUETANG Online*, *MOOC China* and so on [6]. Through the integration of information and network technology, high-quality education will be sent to all parts of the world, while providing a complete learning experience and demonstrating the possibility of integration with the current higher education system [7].

Compared with traditional classroom education, MOOC adhere to the concept of comprehensive opening. Not only is the course registration open, but also the course content, learning time, learning methods and learning evaluation. Learners can participate in the teaching of famous universities around the world, such as Stanford, MIT and Harvard. Although MOOC courses are not taught in the "face-to-face" interaction of traditional classes, there is no lack of personalized interaction. Meanwhile, different from the traditional course, each MOOC takes no more than 20 minutes to focus on telling or solving a certain knowledge point or problem, which makes learners more focused and helps them master the key points. Furthermore, at present, all MOOC online courses are free courses, which is one of its important advantages [8].

4.2 CDIO

CDIO project education is a newly emerging education way, which represents “Conceive”, “Design”, “Implement” and “Operate” in the cycle from product research and development, as shown in Fig 2 [9]. At present, nearly 100 universities in China have carried out pilot work in mechanical, electrical, agricultural, forestry, medical and other majors. The education mode of CDIO engineering has had a positive and extensive impact on the education field of engineering in China.

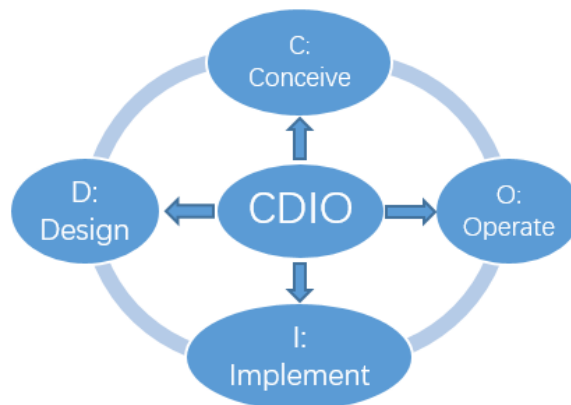


Figure 2. Content in CDIO project education

The CDIO training syllabus divides the abilities of engineering graduates into four levels, which are “basic engineering knowledge”, “personal ability”, “interpersonal team ability” and “engineering system ability”. It enables students to fully grasp the whole process of the conception, design, implementation and operation of electronic engineering products. Besides, students' practical ability and innovative spirit will be cultivated through the implementation of CDIO project. All the projects are team cooperation projects, during which students learn to comprehensively apply knowledge, exercise team spirit, learn project organization methods, cultivate practical innovation ability, professionalism, sense of responsibility and other qualities.

5. Conclusion

Open lab is an effective way for talent cultivation, and it is the unavoidable trend of lab building and development. Effective lab operation and management provide better condition for it to run successfully. This paper discusses on the significance of the open lab, its operation and management. Also, it sets examples like CDIO and MOOC. However, there are still some detail problems about open lab management and utilization rate, which still needs to be considered in the future.

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