

## The Experimental Teaching Arrangement under Limited Teaching Resources

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**Abstract:** This paper expounds the problem of obviously insufficient laboratory resources under the premise of double increase of students and experimental hours. In combination with the limited experimental teaching resources of National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education (Tianjin Agricultural University), this paper analyzes how to plan experimental teaching resources as a whole, build experimental teaching platform with limited experimental teaching resources, reasonably arrange experimental teaching, and improve quality and effect of experimental teaching, and it puts forward discussion on training comprehensive and innovative talents suitable for social development needs.

### 1. Introduction

In the Opinions of the Ministry of Education on Accelerating the Construction of High-level Undergraduate Education and Improving the Ability of Talent Training, it is proposed that the proportion of practical teaching shall be further improved; and in the Opinions on Strengthening the Combination of Agricultural Science and Education and the Implementation of Agricultural and Forestry Talent Education and Training Program 2.0 of the Ministry of Education, the Ministry of Agriculture and Rural Affairs and the National Forestry and Grassland Administration, it is clearly required to strengthen the practical teaching of agricultural and forestry students, and complete the innovation and entrepreneurship system with agriculture and forestry characteristics. Many colleges and universities have positively responded to the call of the state, and they have increased the intensity of practical teaching in the process of revising talent training program. The experimental hours have been increased accordingly. And the proportion of class hours has increased from about 20% originally to 30%-40%. Some experimental classes are independently taught and independently assessed. In the experimental operation, students have deepened their understanding of theoretical knowledge, exercised their ability to combine theory with practice, and their ability to find and solve problems, which play a significant role in promoting the training of innovative and entrepreneurial talents.

However, under the situation that the laboratory area is relatively fixed and the premise that both students and experimental hours are increasing, the laboratory resources are obviously insufficient. How to plan the experimental teaching resources as a whole and reasonably arrange experimental teaching under the limited teaching resources is extremely important. On the one hand, efficient laboratory course arrangement plays a significant role in the smooth operation of the daily work of the laboratory and the effective use of laboratory resources [1]. On the other hand, under the conditions of the limited laboratory resources, scientific and reasonable course arrangement is of great help for students and teachers to arrange their teaching time reasonably, which greatly improves the efficiency of teaching work.

## **2. Problems Existing in the Current Limited Laboratory Teaching Resources**

With the increasing expanding of the enrollment scale of colleges and universities in China, the gross enrollment rate of students is also rising, which makes the elite education in colleges and universities gradually transform into popular education. The emergence of popular education enables most students to receive higher education, and improves the overall quality of the citizens. However, it also leads to the increasingly intense education environment and teaching resources of students. Compared with classroom resources, the laboratory teaching resources are more intense, because classrooms have large lecture halls to accommodate multiple classes together, while an ordinary laboratory can only accommodate about 30 people in a class to the most. Some comprehensive big experiment requires half a day at a time, and calculating like this, if a laboratory operates all day long, it can only accommodate the experiments of up to 10 shifts a week. In addition with the deep-rooted concept of colleges and universities that pays more attention scientific research rather than teaching, more laboratories are given for scientific research, while fewer are used for teaching. Taking National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education (Tianjin Agricultural University) as an example, there are only 3 comprehensive laboratories which can accommodate 30 people and 3 professional laboratories which can accommodate 10-15 people that are used for the teaching at the East Campus. At small laboratories, students have to be divided into groups for experiments, which make teachers repeat their work, and also waste the laboratory teaching resources and students' time accordingly. Besides, due to the lack of laboratory equipment, some courses have to be grouped to conduct experiments, leading to the low utilization of laboratory resources. Due to the above situation, some courses have to be arranged on Saturday and Sunday or even the national statutory rest days. Under such circumstance, the enthusiasm of teachers and students on experimental courses drops sharply, which seriously affects the experimental teaching effect and the improvement of students' experimental ability [2].

## **3. Specific Ways to Improve Experimental Teaching Resources**

### **3.1 Explore Experimental Teaching Arrangement Form According to Categories of Experimental Courses**

In the preparation stage of teaching tasks, determine the number of weeks of classes and whether they are in the same class or in different groups and other situations with the teachers according to the categories of experimental courses and their cohesion with theoretical courses, reasonably arrange the time to make effective use of laboratory space, and achieve the whole-day occupation of teaching laboratories. Respectively assign students into different laboratories according to the requirements of the experimental consumables and instruments in the experimental program. For example, two classes with the same major have Course A and Course B, with a total experimental hour of 20. Assign them to 2 laboratories and adopt the crossed course arrangement. Namely, when Class 1 takes Course A, Class 2 takes Course B, then exchange them, which not only saves the time of students, but also makes full use of laboratories. If the two experimental courses need to use the same laboratory, the before-after course arrangement can be adopted. For example, Course A is arranged from 1-8 weeks, Course B is arranged from 9 -14 weeks, and Course C is arranged from 15-17 weeks. Permitted by experimental materials, courses with more class hours can be arranged at the first half of the semester, while those with less class hours can be arranged at the later part to make the teaching laboratories be fully occupied during the working day.

### **3.2 Explore Flexible and Diversified Experimental Course Arrangement System with the Teaching Management System**

If operate manually, experimental course arrangement not only will waste the time and energy of management personnel, but also cannot guarantee the accuracy of schedule. If it is combined with the

computer system, requirements of teachers and experiments can be preset, which can rapidly improve the work efficiency. The traditional course arrangement gives priority to theory courses and then experiment courses, which leads to the failure of selecting appropriate time for comprehensive and long-duration experiments, thus resulting in the waste of experimental teaching resources. Therefore, we change the traditional course arrangement mode and make full use of the teaching management system to give priority to experiment courses with long duration and then arrange theory courses alternately. In addition, there are also experimental animals whose biological activities are influenced by seasons and temperature, thus limiting the teaching arrangement of experimental courses. For example, relevant experiments of toads in the experimental course of fish physiology. Toads have strong seasonality and their breeding season is from March to April. And the rise of temperature is not conducive to their temporary breeding. Therefore, priority shall be given to the arrangement of this course. For the experimental courses that need to be grouped, first set the group information, and group according to the administrative class in the grouping information, and then carry out teaching in batches. This kind of course arrangement is suitable for small laboratory area or insufficient equipment, and students from the same class have to be grouped into 2-3 groups to use small-class teaching to achieve the best effect of experiment. Besides, with the utilization of the teaching management system to test scattered laboratories and time that can be arranged can ensure the reasonable distribution of class hours while arranging some experimental courses with small class hours in the spare time.

### **3.3 Optimize Experimental Teacher Resources**

In traditional experimental courses, from the preparation of experiments, to the experiments teaching and guidance, preview and review of experimental reports, and grading of students' experimental operations, they are all under the charge of one teacher. And some teachers have to teach courses of multiple classes in one semester. Such high-load and high-intensity work will bring great pressure to teachers, thus affecting the teaching effect of students. At present, National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education (Tianjin Agricultural University) equips 1-2 experimental tutors for every teacher to form the experimental course group. Before an experimental course is taught, experimental tutors will prepare drugs, reagents, instrument debugging, etc. for the experimental course, and tutor students with the teacher at the class, and through investigate the inadequacies in the experimental classes, experimental teaching methods, experimental operations, etc. from students through the investigation method after class, and then summarize and feed back to the teacher for discussion and improvement to improve the experimental teaching effect.

## **4. Suggestions on Arrange Experimental Teaching Well under Limited Laboratory Resources**

### **4.1 Make Experimental Course Arrangement Plan through Investigation**

Through the investigation of the outline of the experimental course currently offered, the content of the experimental tasks and assessment methods, etc., study and formulate the experimental class plan of the National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education after the discussion of the professional guidance group. Plan, including review teaching tasks and teaching outline to determine the number of experimental projects, class time, teachers and whether need to combine class or not and group, and so on to allocate corresponding laboratories to achieve the one hundred percentage of mutual matching between the three factors of full-time experimental teachers, courses taught, and teaching places and class time [3], make full use of laboratory resources, achieve the maximum use of resources and improve experimental teaching quality.

## **4.2 Explore Experimental Course Arrangement Form According to Categories of Experimental Courses**

Arrange courses according to the priority of the categories of experimental courses [4]. For example, the priority level of core professional courses is higher than that of ordinary professional courses; the priority level of compulsory courses is higher than optional courses; and that of courses with more class hours is higher than those with less ones. Order them according to the levels and then arrange those with higher priority levels. Break down several time units according to the day, for example, 1-2 classes, and 3-5 classes in the morning, 6-8 classes, and 9-10 classes in the afternoon, and choose units with good teaching effect according to priority levels in terms of time arrangement. Laboratories are also used according to the priority level to make the allocation of laboratory teaching resources more reasonable.

## **4.3 Explore the Flexible and Diversified Experimental Course Arrangement System**

At present, the university has only one set of teaching management system, which is jointly used by undergraduates, college students and postgraduates. And when the courses are arranged, public courses and basic courses of foundation colleges are arranged first as well as ideological politics lessons of College of Marxism. And then the authority is opened to the secondary colleges for course arrangement. After these, the selectable units for the arrangement of experimental courses, especially comprehensive experiments that last for half a day are fewer, and some experiments can only be arranged on Saturday or Sunday, which make the great waste of experimental teaching resources. In summary, it is suggested that the National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education develops a set of its own independent experimental teaching system to arrange experimental courses. And the system shall can break down the experimental teaching content into each experimental project [5], achieve human-machine interactive course arrangement, and automatically test whether there is a conflict between students, teachers, and laboratories. Students can choose courses according to experimental projects and those who complete experimental projects can obtain corresponding credits. Functions such as experimental group management, experimental score management, and teacher workload statistics are added auxilarily to make the experimental course arrangement more flexible and more scientific. And the experimental teaching management system shall be gradually developed to a good helper of experimental teaching to promote the construction of the National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education and to improve the work efficiency.

## **4.4 Perfect the Experimental Teaching Platform**

Make use of the website platform of the National Demonstration Center for Experimental Aqua-ecology and Aquaculture Education (Tianjin Agricultural University) to upload relevant experiment outline, experiment courseware, experiment preview video and relevant learning materials, so that students can know the possible problems of the experiment in advance and make corresponding solutions to the problems. In this way, students can conduct formal experiments in a targeted manner under the previewing conditions, which not only can improve the quality and effect of experimental teaching, but also can make student be conduct experiments quickly without wasting experiment time, thus improving the utilization rate of laboratories.

## **5. Conclusion**

The arrangement of experimental courses can ensure the unity of theory courses and teaching management. Doing each link of experimental course arrangement well, continuously perfecting experimental course arrangement mode, and effectively improving experimental teaching quality according to the actual teaching situation of the college is an important guarantee for the orderly teaching. The optimization of experimental teacher combination is beneficial to the mutual promotion of teachers' capabilities, the achievement of better experimental effect, the improvement of experimental teaching level, the stimulation of students' learning motivation, and the cultivating of

experimental interests. Through the operation of experimental teaching system, the organic unity of college, teachers, students, laboratories and experiment management personnel can be achieved, which lays a foundation for reasonable arrangement of experiments under the limited experimental teaching resources.

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