An Experiment Resource Reservation Strategy Based on Rigid Demand and Reputation

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Abstract. With the increasing investment in teaching and scientific research, universities have established high-level experimental teaching centers. In order to make full use of laboratory equipment resources, more and more laboratories have established an open sharing system. However, due to the outstanding problems such as the large number of students, the wide range of majors, the small number of full-time experimental personnel, and the long time opening, there are inevitably some scrambles and sometimes vacancy in the process of opening and sharing, so the experimental resources cannot be used with the maximum efficiency. Based on the traditional time priority reservation strategy, it comprehensively considers the reputation problems caused by breaking the reservation and canceling the reservation, as well as the resource demand weight near the course acceptance, and proposes a multi parameter laboratory resource reservation strategy based on rigid demand and reputation. It uses convenient and fast information technology to balance the density of resource occupation, to achieve a fair and reasonable optimization of reservation strategy, so as to improve the efficiency of laboratory resource use and the quality of practical teaching.

Introduction

Laboratory is the necessary environment for higher education to cultivate innovative talents and achieve the goal of excellent engineer education. It plays an active role in realizing the goal of quality education, improving students' scientific research ability, self-management ability and cooperation ability. The open experimental course not only solves the difficulties of arranging courses for a large number of students in a fixed time and a fixed class, but also relieves the pressure of the shortage of experimental equipment. At the same time, it can greatly promote the enthusiasm of students' independent learning, and is conducive to providing a variety of comprehensive open experimental teaching modes and teaching methods with different levels of characteristics [1,2,3]. In order to maximize the utilization rate of laboratory resources, it is urgent to study how to coordinate the occupation of laboratory, reservation of equipment and rotation of professional instructors, describe and analyze the factors of students' reservation behavior, and study the targeted, reasonable and applicable reservation strategies that meet the characteristics of laboratory operation.

Single Parameter Reservation Strategy Based on Time

Time First Reservation Strategy

Resource reservation is widely used, such as medical outpatient appointment, exhibition place appointment, wireless channel resource reservation and so on [4, 5, 6]. The simplest reservation model is first come, first serve or time reservation, but in the actual teaching work, it is often necessary to give full consideration to the identity of students, the use of resources and the specialty of teachers on the basis of the priority of reservation time. Therefore, on the premise of the priority
strategy of reservation time, the following basic reservation principles should be set: A. priority of compulsory courses; B. priority of students in course selection; C. priority of teaching use over scientific research; D. priority of large-scale instruments in short supply to students in related majors; e. open reservation instruments and time periods associated with the majors of the teachers on duty.

Under this premise, the fair reservation model of first come first serve is adopted. When the resource occupancy information is updated in real time, the efficiency of the laboratory environment and equipment can be effectively improved. However, the biggest problem of this strategy is that it ignores the resource idle brought by the break of reservation and cancellation of reservation.

### Over Delivery Of Resources Considering the Breaking Reservation

When the advance time of reservation is long and the social work of students is frequent, and there are no effective punishment measures, the occurrence of breaking the reservation and being late is inevitable. With reference to the overbooking system of air tickets of civil aviation and the overbooking policy of medical outpatient appointments [7], we can adopt the strategy of over delivery of resources. For requests exceeding the available resources, the queue will be set. In case of the behavior of breaking the reservation or being late, the requests in the queue will be automatically converted to the waiting for reservation status and sent the negotiation request through the message. The waiting for reservation status confirmed in time will be automatically updated to the formal reservation, and the waiting for reservation not confirmed in time will be returned to the request queue. The strategy of over delivery of resources effectively prevents the resource vacancy caused by breaking the reservation. It is feasible to send negotiation messages in real time through Wechat platform.

### Resource Supplement Considering the Cancelling Reservation

Compared with the behavior of breaking a reservation, it is normal and unnecessary to accept punishment to cancel the reservation in advance. However, the cancellation of reservations that may occur frequently also needs to be solved by the way of resource over delivery and reservation request queue. When reservation resources are released in the system, the reservation in the request queue is resolved first. In order to reduce the negotiation message of the queue, the queue value should not be set too large (work experience value is 3-5). When there is no waiting reservation in the system, the released resources can be reserved again.

### Full Utilization of Fragment Time Period

Considering the characteristics of school management and free time of students, the time period of reservation is most suitable to take hours as the basic unit. But learning itself is very difficult to be constrained by fixed time length, so there will inevitably be "release time" in the reservation period, and the probability of these pieces of time being idle is very high. The biggest advantage of Wechat platform is the real-time sending of messages. For the short fragment time period, the optimization scheme is pushed the information to the groups who are in the reservation period for experiments. Obviously, extending the experiment time of the students on site is better than re-providing the appointment flexibility, and the actual efficiency is higher.

### Multi parameter reservation strategy based on rigid demand and reputation

#### Resource Demand and Differentiated Service Weight

The single parameter reservation strategy based on time only considers the reservation queue on the time axis. Although it has the fairness for students, it ignores the consideration of education objectives and quality. For the students who are close to the examination or acceptance and the students who are about to graduate, we can't simply use "Before the opportunity, everyone is equal". Under the premise of limited resources, urgent deadline and uncontrollable available time, the opportunity of lottery is not suitable for the delivery of teaching resources. Therefore, the urgency of students' demands should be fully considered in the reservation strategy. At the same time, if the
dishonesty and late behavior has never been punished and limited, it will further worsen the reserving environment, resulting in a large number of resources suddenly idle. Therefore, the reservation strategy also needs to define the reputation value according to the history of students' breaking the reservation, and provide the differentiated service mechanism with weight.

A Mixed Reservation Strategy Based on Long-Term and Short-Term

In the experiment resource reservation strategy, the biggest problem is to find the best use efficiency and achieve the best teaching effect for the given laboratory environment equipment. The so-called optimal strategy needs to fully consider the maximization of time utility and the rigidity of demand. For this reason, it designs a mixed timeslot reservation model combining long-term and short-term (the reservation process is shown in Figure 1). Two stages of the reservation need to take into account the break and cancellation rate. The long-term reservation stage provides sufficient time advance. Students can plan the learning time and duration in advance, and reserve experimental resources as needed. The strategy of long-term reservation is based on time priority and aims at maximizing time utility. The advance time of long-term reservation can be set as 1 or 2 weeks.

The short-term reservation provides the experiment resources of the day or this week, which is generally applicable to the summative learning or final debugging test before the end of class or acceptance. The short-term reservation strategy is based on the urgency of the demand, and the system gives a high demand weight to some student groups according to the course situation, such as the class close to the end of the course, the group close to the acceptance, the graduate class students, etc. Under the premise of calculating the weight, time priority strategy is still adopted to reduce the vacancy rate of resources and fully reflect the openness and fairness. The advance time of short-term reservation can be set from one day to one week.

Under the premise of a certain reservation capacity of experimental resources, the long-term and short-term reservation resources are put in batch. The system judges the logical relationship between the reservation request and the usage period, and decides whether to accept or reject the arrived

Figure 1. Flow chart of mixed timeslot reservation strategy.
reservation request in real time through the preset priority of the system. According to the evaluation of each reservation behavior and actual performance behavior, reputation value is given, and reference to the change of reservation frequency, the distribution of students' reservation requests is obtained through dynamic data, so as to optimize the open teaching arrangement.

**Reservation Implementation and Strategy Verification Based on Wechat**

With the rapid development of Internet and new media, Wechat platform has become a popular communication and social tool for students due to its wide application, convenient communication experience and rich multimedia display function [8]. The reservation strategy proposed in this paper has been implemented based on Wechat programs, and open reservation has been implemented for three experimental courses. In this paper, the reservation data of USRP equipment and computer network switching equipment in a semester are calculated respectively, and the average weekly occupation time of the two equipment is given (Solid line in Fig.2). At the same time, according to the experience of previous years, the average weekly occupation time (dotted line in Fig.2) of equipment without reservation is given. As shown in Fig.2, after the implementation of the mixed reservation strategy, the efficiency of the reservation about one month before the end of the classes are effectively improved. By using smart phones, students can not only arrange learning anytime and anywhere, and get the status of resource occupation every moment, but also avoid invalid offline waiting, and reallocate and release resources and fragments at any time.

| Reserved Equipment | USRP | Network Devices |
|--------------------|------|----------------|
| Number of sets     | 20   | 12             |
| Course duration    | 1st-16th week | 1st-8th week   |
| Number of students | 400  | 320            |
| Members of each group | 1-2 | 2-4            |
| Time required per capita | 6 hours | 6 hours        |
| Weekly available hours / set | 40 hours | 40 hours       |
| Total available hours/ week | 800 hours | 480 hours       |

**Table 1. The Basic data of the reserved equipment in the laboratory.**

![Figure 2. Average occupancy time of laboratory devices in one semester.](image)

**Summary**

In this paper, it discusses the resource reservation strategy of the open laboratory. On the basis of the time first reservation model, considering the canceling and breaking the reservation, a multi
parameter reservation strategy based on rigid demand and reputation is proposed. It not only ensures the fairness of reservation, but also takes into account the urgency of students with rigid demands. Efficient reservation can not only help to reduce the invalid waiting of students, but also provide high-quality teaching services and experience through good resource allocation strategies, minimize the impact of demand fluctuation on resource occupancy efficiency, and alleviate the current situation of overload operation of facilities in a specific period.

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