

# Exploration of University Laboratory Accreditation System for Cultivating Innovative Talents

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**Abstract:** With the in-depth implementation of the national innovation-driven development strategy in colleges and universities, the investment and support for the construction of university laboratories at all levels are increased in China. However, most university laboratories still have some serious problems, such as lack of long-term scientific planning for construction, imperfection management system, outdated laboratory equipment and low utilization rate. In the process of cultivating innovative talents, university laboratories are responsible for stimulating the interest in innovation of students, promoting the realization of innovative ideas, and finally cultivating innovative talents. The laboratory accreditation system in colleges and universities promotes the integration of experimental teaching with modern industry, enables students to have scientific laboratory management experience and qualified experimental technology level, and can promote students to form innovative thinking in practice and promote the further development of innovative talent training mode. On the basis of analyzing the existing problems of university laboratory, this paper explores the establishment path of university laboratory accreditation system for the cultivation of innovative talent, and practices the teaching goal of promoting the cultivation of innovative talents by experimental teaching. The construction of the laboratory accreditation system can not only provide innovative talents with strong professional skills for social development, but also improve the management level and technical ability of the laboratory.

**Keywords:** Laboratory Accreditation, Innovative Personnel Training, University Laboratory

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## 1. Introduction

Innovation is the driving force behind technological development and social progress, as well as an important driving force for our country's national rejuvenation in the new era. "Strengthen the cultivation of innovative talents, especially top-notch innovative talents" is proposed in "China's Education Modernization 2035" [1]. In the new era, cultivating innovative talents has become a new goal of higher education. University laboratories are the core bases for scientific research workers to conduct academic research and technological innovation, and are also the frontiers for the practice of cultivating innovative talents to drive technological development. Colleges and universities improve students' experimental technical level through experimental

teaching, stimulate students' innovative awareness in practice, and achieve the purpose of training innovative literacy. Training innovative talents through laboratories has become the focus of higher education [2].

In recent years, with the gradual practice of the national innovation-driven development strategy in colleges and universities, the investment and support for the construction of university laboratories at all levels are increased in China. The laboratory equipment is constantly updated, and it is developing steadily towards a higher-end, more precise and more comprehensive direction. The academic qualifications, experimental technical level and scientific research ability of laboratory teaching and management personnel are gradually

improving. However, there are still serious problems such as the lack of scientific planning for the long-term construction of most laboratories in colleges and universities, the incompatibility of the laboratory management system with the innovative talent training concept, and the low utilization rate of instruments and equipment [3-5]. The laboratory cannot fully practice the requirements of innovative talent training. The concept of laboratory accreditation can strengthen the quality management system of the laboratory, so that the testing experiment can improve the accuracy and reliability of the testing data using instruments and equipment under the scientific and standardized management. The construction of the laboratory accreditation system in colleges and universities can enable students to understand the scientific laboratory management system, have professional experimental technical standards and comprehensively improve the original innovation ability of students. It also can cultivate high-quality talents with professional practical ability and innovative vitality.

## 2. The Status Quo of Laboratory Accreditation in Colleges and Universities

The laboratory accreditation system in China is a kind of evaluation of testing/calibration laboratories and inspection institutions by China National Accreditation Service for Conformity Assessment (CNAS) in accordance with the "General Requirements for the Capability of Testing and Calibration Laboratories". The mechanism is the recognition of the technical ability and management level of the laboratory [6, 7]. CNAS is a full member of the Asia Pacific Laboratory Accreditation Cooperation (APLAC) and the International Laboratory Accreditation Cooperation (ILAC). The testing, inspection, and calibration reports/certificates issued by CNAS-accredited laboratories are of international use [8-10].

At present, the development scale of laboratories in universities and research institutes in our country is gradually increasing, and the number of laboratories is also increasing rapidly. Many university testing laboratories have passed the official accreditation of CNAS through self-improvement and continuous improvement.

The development of the laboratory accreditation system in China is shown in Figure 1. As of November 13, 2021, there are 10,729 testing laboratories accredited by CNAS nationwide, of which 213 are university laboratories, accounting for about 2.0%. There are a total of 1,548 calibration laboratories accredited by CNAS, of which 9 are university laboratories, accounting for about 0.6%. There are 528 other laboratories accredited by CNAS, of which 34 are university laboratories, accounting for about 6.4%. It can be seen that the proportion of university laboratories accredited by CNAS in various laboratories is relatively low, indicating that university laboratories have greater room for improvement in laboratory accreditation.

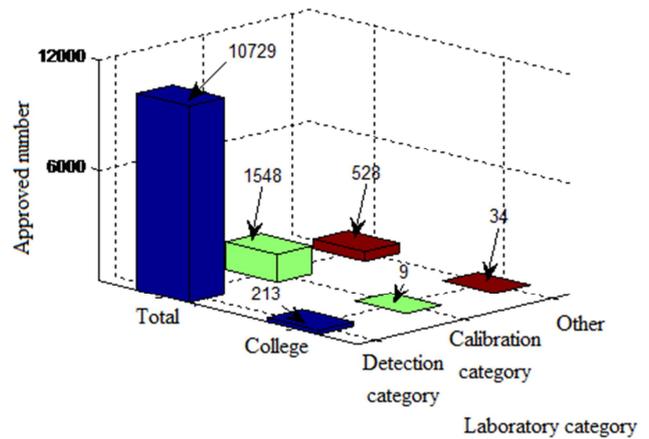


Figure 1. Laboratory accreditation statistics.

## 3. The Significance of University Laboratory Accreditation

### 3.1. The Demands for Innovative Talent Training

The cultivation of innovative talents is a process of stimulating innovative ideas by practice, cultivating innovative thinking and forming innovative ideas. Students can improve the experimental level after entering the laboratory and accepting the teacher's experimental teaching. However, the traditional experimental teaching is single-oriented and the teaching method is relatively boring. The experimental skills developed by students in the process of learning experimental techniques cannot be effectively exercised in social practice, and the learning efficiency will be reduced due to the reduction of students' learning initiative, and it is difficult to fully stimulate students' innovative interest. With the passage of time, students gradually lose their enthusiasm for learning, their experimental skills become increasingly unfamiliar, and they directly lose their interest in innovation. The university laboratory certification system can improve the laboratory management system and optimize the experimental process. Through the standardized and scientific guidance of teachers, students can understand advanced laboratory management concepts and master professional experimental skills. In the process of open service in the laboratory, students will contact the society, so as to understand the needs of the market and enterprises, ask questions, challenge questions, form innovative ideas, and conduct experimental verification after rigorous scientific reasoning. In the continuous experiment, the final problem-solving sense of achievement achieves the effect of continuously stimulating innovation interest, tempering scientific research innovation literacy, and growing into innovative talents [11-13].

### 3.2. The Demands of Laboratory Science Management

In recent years, the scale of university laboratories has expanded rapidly, and the scale of laboratory teaching has also gradually expanded. Laboratory teachers in colleges and universities undertake more teaching tasks and scientific research work, and the management of laboratory personnel

and instruments and equipment is gradually conflicting with the growing scale. Laboratory personnel management lacks standardization, and graduate students undertake part of the laboratory management work. Due to the high mobility of students and the fact that postgraduates themselves have scientific research tasks, without professional training and assessment, students' management ability and experimental technology and other business levels are mixed. In addition, the responsibility and work efficiency of managers directly affect the construction and management level of the laboratory. Establishing a professional and high-quality laboratory technical team and cultivating a management team with strong professional skills and strong sense of responsibility are the basic tasks of laboratory construction and management in colleges and universities. The laboratory accreditation system puts personnel first, and requires scientific and standardized training for management personnel to promote the high-quality completion of experimental teaching. The formation of a comprehensive scientific management system in the laboratory can improve the effective utilization of instruments and equipment and reduce equipment maintenance costs [14, 15].

### 3.3. The Demands of University Laboratory Data Reliability Guarantee

Due to the unstandardized quality management system of some university laboratories and uneven technical skills of laboratory personnel, the objectivity and accuracy of experimental testing data are affected, and the reliability of testing data of university laboratories such as enterprises, scientific research institutions and other social organizations cannot be guaranteed, taking the results only as reference [16-20]. The assessment process of laboratories in the CNAS accreditation system is a complete set of procedures that

strictly abide by the assessment requirements, and the technical level of the accredited laboratories and the accuracy of the test results have been recognized. The reports issued within the testing scope of the laboratory accreditation business are widely recognized by the ILAC, and the reliability of the testing data can be guaranteed.

### 3.4. Promote the Formation of a Full Chain of Deep Integration of Industry-University-Research

Laboratory accreditation helps university laboratories improve and perfect the laboratory system, and serve enterprises and other scientific research units with professional experimental level and reliable testing data. The integration of experimental teaching and social production to realize the combination of production and education can enhance the social competitiveness of the laboratory. In the process of accreditation, college experiments constantly improve the shortcomings of experimental teaching, and implement high-quality and high-level experimental course teaching. Through the effective feedback obtained in the teaching process, the teaching methods can be improved in time to promote the cultivation of innovative talents. The scientific management system and staffing have created a good research environment for scientific researchers, which is conducive to the formation of an open and rigorous academic atmosphere. Researchers generate innovative ideas and conduct high-level scientific research. At the same time, under the promotion of the laboratory accreditation system, the research results can be quickly applied to social production. Finally, a chain of deep integration of industry-university-research will be formed, and a cooperation system of mutual benefit and win-win between universities and enterprises, universities and society will be created.

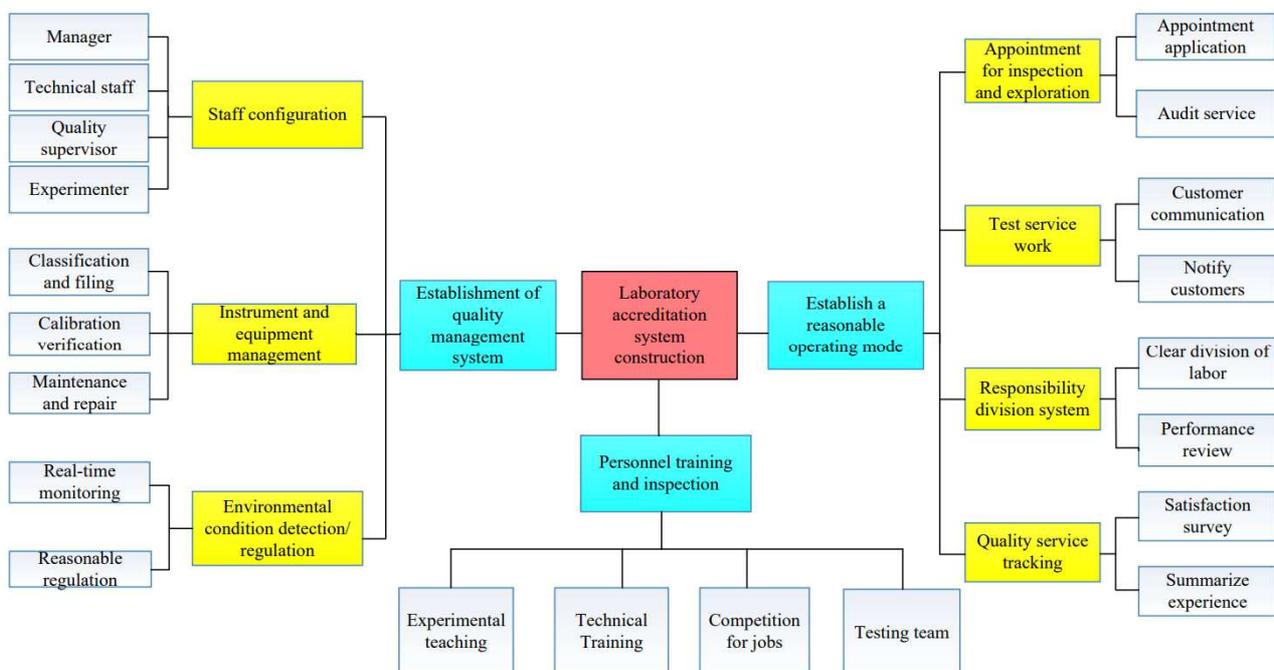


Figure 2. Construction of laboratory accreditation system.

## 4. Laboratory Accreditation System Construction

According to the requirements of ISO/IEC17025:2017 "General Requirements for the Competence of Testing and Calibration Laboratories" and CNAS-CL01:2018 "Criteria for Accreditation of Testing and Calibration Laboratories Competence", the laboratory accreditation system consists of five elements: personnel, machine, sample, method and environment. Combined with the actual testing laboratories and calibration laboratories of the School of Quality and Technical Supervision of Hebei University, the construction of laboratory accreditation system construction is divided into three parts: establishment of quality management system, personnel training and inspection and establishment of laboratory operation mode, as shown in Figure 2.

### 4.1. Establishment of Quality Management System

Laboratory quality management is an activity of commanding, controlling and coordinating in terms of quality. It integrates, optimizes and improves quality on the premise of clarifying the laboratory quality policy and quality objectives. The main application of quality management in the university laboratory accreditation system is the management of personnel, equipment and facility environment requirements.

The testing laboratory and calibration laboratory of the hospital are staffed by managers, technicians, quality supervisors and laboratory personnel. Managers are required to be familiar with the operation mechanism of the laboratory accreditation system, be responsible for determining the quality policy and quality objectives of the laboratory, and coordinate the overall resource allocation of the laboratory. The technicians should be familiar with and master the testing technical requirements of the laboratory, train the laboratory personnel, and carry out routine maintenance of the laboratory equipment. Experimenters are teachers or students who have undergone systematic training and master laboratory-related testing techniques, and are responsible for testing specific items. Quality supervisors must be familiar with the entire process of the laboratory's testing work and master the technical requirements of testing methods, and are mainly responsible for the supervision of the testing process and the verification of testing data.

The management of instruments and equipment under the laboratory accreditation system includes the classification and filing of equipment, calibration verification and maintenance. Classification is to classify the functions of the equipment, and filing is to record the operation status of the equipment, the person in charge of equipment maintenance, the equipment operator, the operation process, maintenance history, calibration, etc. Technicians regularly calibrate the equipment and check the accuracy of the experimental results. The maintenance and repair management of the equipment by the person in charge of equipment maintenance can reduce the probability of failure during the experiment and increase the

service life of the equipment.

When laboratories test/calibrate different items, the sensitivity of the tested items to different changing conditions of the facility environment is significantly different. According to the requirements of the "Criteria for Accreditation of Testing and Calibration Laboratory Capability", real-time monitoring and accurate recording of environmental conditions should be carried out for the testing items that are sensitive to the facility environment, and the implementation environment should be controlled within the range that does not affect the accuracy of the testing results.

### 4.2. Personnel Training and Inspection

Personnel are the key to the normal operation of the laboratory, and the business ability and professionalism of the relevant laboratory personnel directly affect the objectivity and accuracy of the test data. Therefore, laboratory staff must go through training and study, and only after passing the assessment can they be certified to work. Those who do not meet the standard continue to receive training until they meet the assessment requirements. This effectively avoids the problem that the experimental ability of technicians is reduced due to the flow of personnel, resulting in unreliable test results. The laboratory teaching staff have been trained to regularly inspect and maintain the instruments and equipment, improve the laboratory's testing ability and the reliability of the testing data, integrate the learning of the laboratory accreditation system into the experimental teaching, and strictly examine the experimental technical level of the students. Students join the professional testing team through competition to become experimental staff. In the practice process of completing the project testing, the innovative thinking of students is cultivated, and the teaching mode of promoting the cultivation of innovative talents with laboratory accreditation is gradually improved.

### 4.3. Establishment of a Reasonable Operation Mode of the Laboratory

University laboratories under the laboratory accreditation system have scientific management models and high-precision testing instruments, cultivate high-tech and high-level laboratory technicians, and form a professional testing technical team. The laboratory operation first implements an appointment testing application system, applying for an appointment through the WeChat public account or a small program, and then the staff will review it. Actively communicate with customers after accepting the test service application, and notify the customer after the test is completed. Implement the clear analysis of the duties of the staff in the operation stage, and each link has a special person responsible for it, and implement performance appraisal. After completing the testing service, we will pay a return visit to customers to investigate the satisfaction of the service, actively summarize experience, and continuously innovate and reform the operation mode.

Opening up scientific research resources to the society can improve the equipment utilization rate of university laboratories. Use a professional scientific research team to solve the testing problems faced by enterprises, provide systematic solutions, and reflect the function of colleges and universities to serve the society with scientific research. Then in the process of deepening industry-university cooperation, it will promote the transformation of scientific and technological achievements. Colleges and universities have the independence of scientific research, are less affected by the outside world and the market economy, and have objectivity as testing institutions. In the process of actively integrating with the social industry, colleges and universities invest abundant scientific and technological resources into the construction of social industry to affect economic development, which in turn will be affected by the market economy. The influence of the market economy competition system in university laboratories will enhance the sense of competition. The healthy competition between laboratories will help to enhance the service awareness of experimenters, and stimulate the formation of innovative thinking of experimenters to improve their competitiveness by improving existing technologies. Of course, the market economy will make the testing of laboratory projects more profitable. If the charging system is implemented, it will increase the workload of scientific researchers and make scientific research work interfered by the market economy. Therefore, the responsibilities of scientific researchers in the reasonable operation mode of university laboratories cannot include the service of testing fees, and special staff should be arranged to be in charge of finance.

## 5. Recommendations

Through the analysis of the existing problems of the laboratory, and the needs of the training of innovative talents and laboratory management, suggestions on the construction of laboratory accreditation system from three aspects are put forward in this paper. Such as quality management system, personnel training and laboratory operation mode. The specific implementation of these measures will have positive significance for further improving and promoting the establishment of university laboratory accreditation system.

## 6. Conclusion

The laboratory accreditation system continuously refines and improves the operation and management system of the laboratory, which can promote the integration of university laboratories with enterprises and other scientific research institutes, and share university scientific research resources. The exploration of the university laboratory accreditation system for the cultivation of innovative talents is the specific practice of the national innovation-driven development strategy. Cultivating talents with a scientific experimental management system can give full play to the advantages of experimental teaching, and provide top-notch talents with

strong professional skills and vitality for scientific and technological progress and social development.

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