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# Research on Optimization of University Academic System Conducive to Cultivation of Innovative Talents

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## Abstract
Cultivation of innovative talents is the top priority of higher education in China. The academic system of colleges and universities is the most important places for cultivating innovative talents. Through the analysis on the subsystems of academic resources, credit system, cultivation of students' innovation ability, and academic operation management, the paper proposes the optimization of the academic system for the cultivation of innovative talents.

**Key words:** Cultivation of innovative talents; Academic system; Optimization

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## INTRODUCTION
Innovation is the most fundamental element of national progress, and it is the endless motivative force of the prosperity of the nation. The competition in modern countries has now become the competition of innovative talents. Cultivating innovative talents has become a national importance and a prerequisite for building an innovative nation and the enhancement of the independent innovation capacity. One of the most important functions of higher education in China is the cultivation of talents. The cultivation of innovative talents is the top priority of higher education in China. The late distinguished scientist Xuesen Qian had asked the former Premier Wen Jiabao six times, "Why does our education system always fail to cultivate outstanding talents?" This is the famous "Question by Xueshen Qian." He also pointed out, "Currently, Chinese universities rarely educate the students in the way of cultivating talents in science and technology. Students are lack of unique and innovative thoughts, and there is no outstanding talent." (Lai, 2012) Therefore, with the goal of building an innovative country, China's higher education should assume the historical responsibility of cultivating innovative talents.

## 1. ACADEMIC SYSTEM IN HIGHER EDUCATION
The university academic system refers to an integrated system that is composed of various academic elements and functions for the purpose of achieving academic goals. The academic system is an important part of the university education system and an important mean and place for cultivating innovative talents. The academic system is a complex system composed of various elements. It is mainly composed of four subsystems: academic resources, credit system, students' innovation ability cultivation, and academic operation management.

The optimization of the academic system, which is conducive to the cultivation of innovative talents, in colleges and universities is based on the system theory. It mainly analyzes the internal coordination of the four subsystems of the academic system in order to achieve harmony and unity and to focus on orderly development of the entire system, establishing a relatively efficient, orderly, and stable system in accordance to the cultivation of innovative talents under the influence of various external conditions.

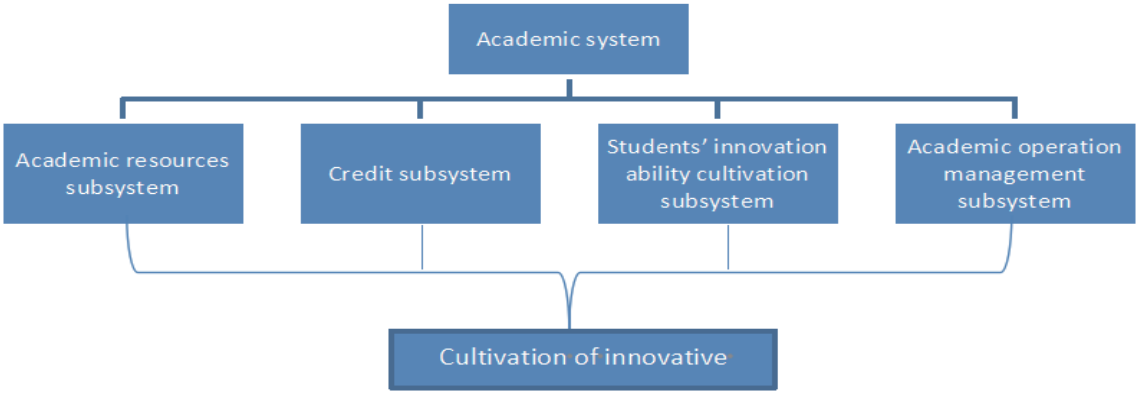


**Figure 1**
**Composition of the Academic System**

## 2. OPTIMIZATION OF THE ACADEMIC SUBSYSTEM FOR THE CULTIVATION OF INNOVATIVE TALENTS: MAINLY FOCUSING ON THE OPTIMIZATION OF THE ACTUAL STUDENT-TEACHER RATIO

### 2.1 Student-Teacher Ratio, Effective Student-Teacher Ratio, and Actual Student-Teacher Ratio

The student-teacher ratio is the ratio of the number of instructors to the number of full-time students in school. It is an important measure of the academic level of a university (Li, Rao, and Hua, 2016). The "effective student-teacher ratio" in this paper refers specifically to the national standard student-teacher ratio of 16:1, and the actual student-teacher ratio refers to the calculated student-teacher ratio based on the analysis of the teacher's actual teaching time.

### 2.2 On the Actual Student-Skill Ratio Conducive to the Cultivation of Innovative Talents

#### 2.2.1 Analysis of Actual Student-Teacher Ratio in Colleges and Universities

##### 2.2.1.1 Working Hours and Content of the Teachers

The main responsibilities of college teachers include preparing and teaching classes, research, and others (such as after-school Q&A, mentoring students, etc.). The typical working time of a teacher is 8 hrs/day. According to the normal working hours of the school, the working hours for a single year should be: 8 (hours) * 5 (days) * 42 (weeks) = 1680 (hours). Currently, the general workload (the number of class-hours) prescribed by colleges and universities is about 220 class-hours/year, and the typical teaching time of a teacher is 210 days/year. According to this, it can be concluded that the average amount of teaching per day for a teacher is about 1 class-hour. According to the survey, an ordinary college teacher needs at least 3 hours to be fully prepared for a one-hour course to ensure the quality of talents cultivation. At the same time, teachers must conduct scientific research and other work (assuming the time spent on these two tasks is the same). With an 8-hour work schedule, the average work time allocation for college teachers per day is shown in the Table 1:

**Table 1**
**Working Hours and Content of College Teachers**

| Working content of college teachers/day | Working time/day (hrs) |
|---|---|
| Preparation for class | 3 |
| Teaching | 1 |
| Research | 2 |
| Others | 2 |

The student-teacher ratio is based on the teachers' workload. We assume that under the work arrangement mentioned above, the effective student-teacher ratio of ordinary colleges and universities is optimal, that is, 16:1. The teaching capacity of teachers is optimized, and the quality of talents cultivation is guaranteed effectively.

##### 2.2.1.2 Research on the Actual Student-Teacher Ratio in Colleges and Universities—Case Study of a University in the West

A university in the west is one of the key developing universities in China. The current student-teacher ratio is 18:1, which meets the basic requirements of the Ministry of Education and is in an effective state. Based on the interviews and questionnaires conducted on the university teachers, the results showed that the average time spent on scientific research time is about 5 hrs/day while ensuring the quality and quantity of teaching. This indicates that the daily working time will reach 11 hours for the college teachers if they want to ensure the quantity and quality of teaching. This number of hours greatly exceeds the typical number of working hours. The reality is that some teachers often work longer than that. For example, the number of the professors and lecturers in the university is: the number of professors accounts for 21%, the number of associate professors accounts for 42%, and the number of lecturers account for 37%. The numbers of associate professors and lecturers account for a larger percent, and they often undertake a

larger portion of scientific research responsibilities while bearing the pressure of a promotion (or a tenure). Under this circumstance, associate professors and lecturers, who take greater responsibilities in teaching, spend more time on scientific research and other work. This is far beyond the teacher's teaching capacity and will inevitably affect the time and quality of their preparation for classes.

#### 2.2.1.3 Calculation of the Actual Student-Teacher Ratio at a University in the West

When calculating the actual student-teacher ratio, two factors should be considered: one is the overtime work of the teachers, and the other is the actual time spent on teaching by teachers with different professional titles. According to the survey conducted in this university, if the quality and quantity of teaching is guaranteed, then the average overtime is about 3 hours/day. Based on the teaching ratio of teachers with different professional titles, the teaching rate is about 20% for professors and 80% for associate professor and the lecturer. Overall, while ensuring both the quantity and the quality of teaching, the percentage of teachers that actually teach is about 2/3 of the total number of teachers in that university. Therefore, the actual student-teacher ratio of the college is about 26:1, which is higher than the current student-teacher ratio of 18:1.

### 2.2.2 Optimization of the Actual Student-Teacher Ratio

Most colleges and universities in China have done much work to achieve the national standard of student-teacher ratio. For example, colleges with lower student-teacher ratio have expanded their admission scale, and colleges with higher student-teacher ratio have introduced excellent teachers and strengthened their instructors' teams. However, based on the analysis, after taking various factors into account, the results indicate that the actual student-teacher ratio of colleges and universities is often higher than the effective student-teacher ratio. This non-dominant and unreasonable student-teacher ratio seriously affects the quality of innovative talents. To change this situation, the most important thing is to further strengthen the central awareness of academic teaching, to consolidate the key positions of academic teaching, and to improve the quality of academic teaching and follow the path of first-line instructors in terms of job title evaluation. Secondly, we must vigorously introduce exceptional teachers and increase the number of talents. At the same time, it is necessary to keep a steady admission scale and prevent uncontrolled expansion of the schools. Finally, professors are encouraged to step onto the podium, teach the students, and optimize the structure of the instructors through various constraints and incentives.

## 3. OPTIMIZATION OF THE CREDIT SUBSYSTEM CONDUCIVE TO THE CULTIVATION OF INNOVATIVE TALENTS: FOCUSING ON THE "ONE CORE AND FOUR FORCES" OPERATION MODE

The credit system that is conducive to cultivating innovative talents should take the original credit system as the core, take the implementation of the innovative credits as the driving force, take the tuition-by-credit system as the stimulating force, take the guidance by mentors as the supporting force, and the cross-school credit transfer as the promoting force to form the "One Core and Four Forces" operation mode. It provides space, insurances, and motivation for innovation and promotes innovative talents in all aspects.

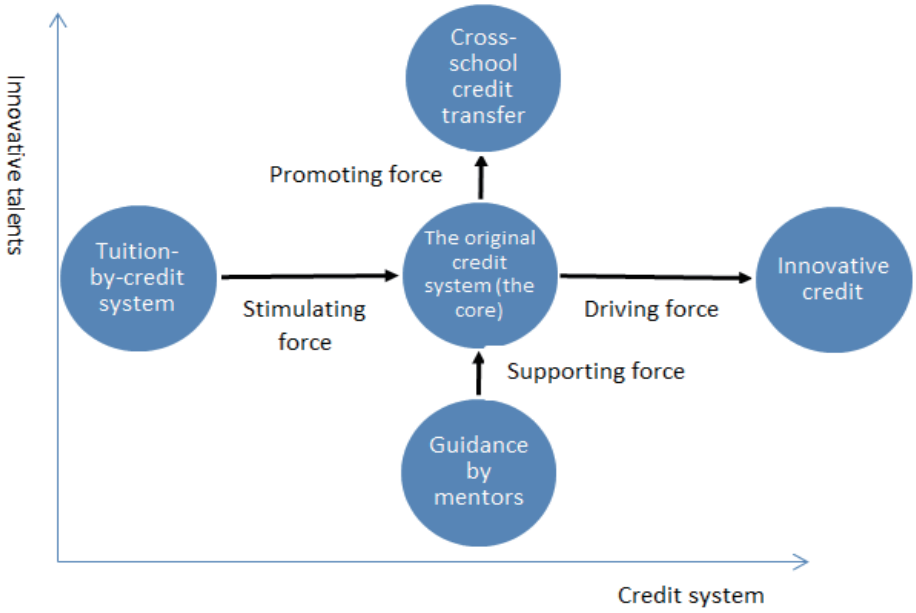


**Figure 2**
**"One Core and Four Forces" Operation Mode of the Credit System Conducive to Cultivating Innovative Talents**

### 3.1 Taking the Original Credit System as the Core

The differences among the various types, scales, and status of colleges and universities in China are significant. Therefore, it is not possible to implement a "one-size-fit-all" credit system in all colleges and universities. Innovation on the basis of the original credit system is needed. This is the key focus of the credit system that is conducive to cultivating innovative talents.

### 3.2 Taking the Innovative Credits as the Driving Force

In order to promote and encourage the individualized development of students, to cultivate students' practical ability and innovativeness, and to let exceptional talents stand out, it is necessary to implement the innovative credits into the system. Innovative credits are credits that students received for learning and practical activities outside of the school based on their own hobbies and specialties. Students will receive credits based on the results obtained during these activities.

### 3.3 Taking Tuition-by-Credit System as the Stimulating Force

In order to improve and promote the credit system and improve the quality of cultivation of talents, colleges and universities can implement the tuition-by-credit system in accordance with the local price regulations and the actual situation of the school. The tuition-by-credit system refers to the separation of the original academic year tuition into two parts: registration fee and tuitions based on the number of credits.

### 3.4 Taking the Guidance by Mentors as the Supporting Force

The schools shall take full advantage of their resources and actively promote the undergraduate tutor system and other targeted measures in order to provide a more personalized guidance for the outstanding students in all aspects such as ideology, academic work, research, and life, and to provide insurance for innovative talents.

### 3.5 Taking the Cross-School Credit Transfer System as the Promoting Force

"Reciprocal recognition of credits" means that students can take additional relevant courses in other schools. These credits earned at another school can be transferred to their own schools and vice versa (Yin and Yao, 2012). Reciprocal recognition of credits broadens the horizons of students and provides them with a good opportunity to master more complex knowledge.

## 4. OPTIMIZATION OF STUDENTS' INNOVATION ABILITY CULTIVATION SUBSYSTEM CONDUCIVE TO THE CULTIVATION OF INNOVATIVE TALENTS: FOCUSING ON THE CONSTRUCTION OF PLATFORM FOR PRACTICE

The essence and key subject of the cultivation of innovative talents is to cultivate students' innovative ability, which is a difficulty in the academic teaching of colleges and universities. To cultivate students' innovative ability, we must not only provide support and guarantee at the theoretical and institutional levels, but also pay attention to the construction of platforms for practice.

### 4.1 Rely on Innovative Practice Base

Establishing a high-level scientific and technological innovation practice base is conducive to consolidating the achievements of scientific and technological innovations and to cultivating talents with true innovative qualities. Colleges and universities should reply on the school's scientific research resources, construct innovation laboratories for students in schools, and cooperate with enterprises and set up innovation practice bases. Students can directly participate projects at schools or enterprises and improve their research abilities (Sun, 2008). This provides a platform for students to develop their innovative abilities.

### 4.2 Give Full Paly of the Role of Innovative Competition Activities

Scientific and technological innovation competitions play an irreplaceable role in guiding students in developing innovative thinking, cultivating innovativeness, and establishing innovative consciousness. On the one hand, it is necessary to give full play to the leading role of academic and scientific works competitions such as the "Challenge Cup" and focus on excavating and cultivating a group of outstanding college students with high innovativeness. On the other hand, it is necessary to hold various scientific and technological competitions based on the innovative practice platforms in the school, to continuously enrich the content and forms, to guide students in participating scientific and technological innovation activities, to create a culture atmosphere of science and technology on campus, and to give full play to these competition activities to cultivate and enhance the innovation abilities and overall qualities of the students.

### 4.3 Expand Students' Practical Activities

Through practical activities such as internship, graduation design, and experimental training, the knowledge learned in class is applied in real-life production. This will train and improve the practical ability and overall qualities of the students. At the same time, cultivating students' innovative ability requires not only a sound theoretical education and practical experiment teaching, but also a close integration with student associations, academic lectures, work-study programs, and campus culture. By participating in various social practice activities, students can not only improve their overall qualities, but also gain a comprehensive and in-depth understanding of society, which will enhance their sense of social responsibility.

## 5. OPTIMIZATION OF ACADEMIC OPERATION MANAGEMENT SUBSYSTEM CONDUCIVE TO THE CULTIVATION OF INNOVATIVE TALENTS: FOCUSING ON INFORMATION CONSTRUCTION

The efficiency of academic operation management affects the quality of academic teaching, and it is also related to the quality of talents cultivation in colleges and universities. In recent years, elements of academic operation management in colleges and universities have been increasing, especially under the current conditions of informationization and networking. The old academic operation management mode has become detrimental to the cultivation of innovative talents. Under such situation, proposition focusing on how to make full use of modern means, strengthen information construction, and improve work efficiency becomes extremely important.

### 5.1 Strengthen the Construction of Academic Operation Management System

Academic operation management system is an important guarantee for standardized academic operation. In the construction of academic operation management system, it is necessary to design a comprehensive, systematic, rigorous, standardized, and operable academic operation management system according to the requirements of academic operation management informationization. The academic operation management system should ensure that all the operational links of the academic teaching have clear informational requirements. With the rapid development of information technology and network, the academic operation management system must keep up with the times and implement supplements and improve the existing academic operation management system in a timely fashion in order to ensure its timeliness and feasibility.

### 5.2 Strengthen the Construction of Information Platform

Currently, some colleges and universities are in the process of academic operation management informationization. Situations, which are not conducive to the effective implementation of academic operation management informationization, such as different informationization progress and lack of communication and coordination of the information construction among the academic operation management departments, exist. The mature network information technology provides a nice environment for the construction of information platform. Based on network information technology support, the academic operation management system includes student status management, admission management, and academic teaching plan, goals and schedules. All information processing sharing during the academic operation management processes, such as course selection, course arrangement, etc. relied on the information platform construction, has greatly reduced the management intensity, improved the academic operation efficiency, and made the information sharing more complete, the teaching resource information is more open and transparent, and the information exchange is more convenient.

### 5.3 Pay Attention to the Construction of Academic Management Team

As the operators and lower-level managers in the academic operation management of colleges and universities, academic managers directly affect the efficiency and level of academic management. With the construction of academic operation management informationization, academic managers should strive to master the informational office tools, improve their abilities on information application, and enhance their work efficiency. Meanwhile, it is necessary to increase the training of academic managers and establish a reasonable evaluation and competition mechanism in order to comprehensively improve the quality of the academic management team and make academic managers competent for information-based academic management.

## CONCLUSION

Based on the analysis and research of the four subsystems of the university academic system, systematic countermeasures and suggestions for innovative talents cultivation are proposed from the perspective of the system as a whole. Certainly, the cultivation of innovative talents is a grand project that requires universities to plan and coordinate in all aspects. If a single university that is based on innovative talent cultivation is regarded as a large system, then that system needs to at least includes an academic teaching system, a scientific research system, and a student work system. The optimization of innovative talents cultivation in colleges and universities is not only an optimization within the academic teaching system, but also an optimization of the relationships with other internal systems and the external environment, which are subjects for further in-depth research.

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