

# Research on Scientific Research and Innovation Mechanism of American Higher Education and Its Enlightenment

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[ **Abstract** ] The purpose of the research on scientific research and innovation mechanism of higher education in the United States is to understand the organization, management, funding sources and distribution, achievement transformation and industrialization, talent training and other mechanisms of scientific research and innovation of higher education in the United States, analyze its characteristics, advantages and disadvantages, and explore its enlightenment on scientific research and innovation of higher education in China, so as to provide reference for the reform and development of scientific research and innovation mechanism of higher education in China. Through the research, we can deeply understand the practice and experience of research and innovation mechanism of American higher education, analyze its advantages and disadvantages, and provide reference for China to formulate more scientific and effective reform scheme for research and innovation mechanism of higher education.

[ **Key words** ] higher education; comparative education; the United States; scientific research and innovation; enlightenment

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## 1 Research Introduction

The scientific research and innovation mechanism of American higher education is an important guarantee for the great achievements of American higher education. American higher education system is closely related to social and economic development. Higher education plays an important role in promoting scientific and technological innovation and economic growth.

### 1.1 Research background and purpose

As the world's leading country in scientific and technological innovation, the United States has significant advantages in the research and innovation of higher education. Its universities and scientific research institutions not only have strong strength and resources in scientific research, but also have formed a perfect mechanism and system in terms of scientific research funds, transformation and industrialization of scientific and technological achievements. The establishment of these mechanisms and systems has played an important role in supporting and ensuring the rapid development of scientific research and innovation in American higher education. At the same time, these mechanisms also provide a lot of enlightenment and reference for research and innovation of higher education in other countries. The purpose of studying the scientific research and innovation mechanism of American higher education is to deeply understand the mechanism and system of it, explore the successful experience and key factors, and provide reference and enlightenment for scientific research and innovation of Chinese higher education. The objectives include: to understand the system and mechanism of scientific research and innovation in American higher education, including scientific research institutions and organizations, sources and distribution mechanism of scientific research funds, transformation and industrialization mechanism of scientific and technological achievements, and cultivation mechanism of innovative talents; to analyze the successful experience and key factors of research and innovation in American higher education, including policies, regulations, culture, social environment and other aspects, as well as the cooperation mode between different institutions and organizations; to explore the development trend and future direction of scientific research and innovation in American higher

education, including strategies and mechanisms to deal with emerging fields and technology development, and how to continue to promote the cultivation of innovative talents and the transformation of scientific and technological achievements.

### **1.2 Research methods**

A variety of research methods can be used to study the scientific research and innovation mechanism of American higher education, including the following: (1) Literature research method. Through the collection, collation and analysis of relevant literature, we have an in-depth understanding of the mechanism and system of scientific research and innovation in American higher education, including policies and regulations, scientific research institutions and organizations, sources and distribution mechanism of scientific research funds, transformation and industrialization mechanism of scientific and technological achievements, and cultivation mechanism of innovative talents. (2) Expert interview method. Through in-depth exchanges and interviews with experts, scholars, practitioners and other people in the field of research and innovation of higher education in the United States, their views, experiences and suggestions in this field, and further key factors and successful experience can be understood. (3) Case study method. An in-depth study of classic cases in the field of research and innovation of higher education in the United States is made to analyze the successful experience and key factors, and explores the cooperation modes between different institutions and organizations, so as to provide reference and enlightenment for research and innovation of higher education in other countries. (4) Field investigation method. By visiting and inspecting the institutions and organizations in the field of scientific research and innovation in higher education in the United States, we can understand their operation mechanism, management mode, the transformation and industrialization of scientific and technological achievements, and the cultivation mechanism of innovative talents, and further understand the key factors and successful experience.

## **2 Characteristics of scientific research and innovation mechanism in american higher education**

The scientific research and innovation mechanism of higher education in the United States refers to a set of systematic mechanisms and policies, including scientific research institutions and organizations, sources and distribution mechanism of scientific research funds, transformation and industrialization mechanism of scientific and technological achievements, and cultivation mechanism of innovative talents. Together, they constitute the ecosystem of scientific research and innovation in American higher education, and promote the continuous development of scientific and technological innovation in the United States.

### **2.1 Scientific research institutions and organizations**

Research institutions and organizations in American higher education mainly include universities, research institutes and laboratories, which play an important role in scientific research, technology development and innovation. The number of higher education research institutions and organizations in the United States is huge, covering many different fields and research directions. These institutions and organizations usually have a good cooperative relationship with each other and jointly promote the continuous development of scientific and technological innovation in the United States. American universities include public and private universities, which have different natures and objectives, but both play an important role in higher education and scientific research. In terms of scientific research, universities mainly include teaching, research and comprehensive universities, with different research fields and levels. Some of the top universities in the United States enjoy high reputation in the world, such as Harvard University, Massachusetts Institute of Technology, Stanford University, etc. Research institutes in the United States are usually funded by the government or private institutions, which are usually committed to research and technology development in specific fields. There are a large number of research institutes in the United States, covering many different research fields, such as national laboratories, government laboratories, enterprise research centers, etc. Laboratories in the United States are usually funded by the government or private institutions, which are committed to scientific research and technological development in specific fields. There are a large number of laboratories in the United States, such as national, government and

enterprise laboratories, which cover many different fields. Among the laboratories, national laboratory is set up by the federal government of the United States, mainly engaged in research and development in national security, energy, environment, medicine and other aspects.

## **2.2 Sources and distribution mechanism of scientific research funds**

The sources and distribution mechanism of scientific research funds for higher education in the United States are very complex, mainly including federal government funding, state government funding, enterprise funding, private donations and so on. The federal government of the United States is the main source of funding for scientific research in higher education, and its funding agencies include National Science Foundation, National Institutes of Health, National Aeronautics and Space Administration, etc. These funding institutions provide financial support to higher education institutions, research institutes and laboratories for scientific research and technological development. In addition to the federal government, U. S. state governments will also provide financial support to higher education institutions within the state for their scientific research and technological development. These grants are usually related to the economic development and social needs of the States. Some large enterprises and innovative enterprises in the United States will also provide financial support to higher education institutions, research institutes and laboratories for scientific research and technological development. These enterprises usually apply the research results to their own production and business activities. Some wealthy people and foundations in the United States donated funds to higher education institutions, research institutes and laboratories for scientific research and technological development. These donations are usually related to the charity and social responsibility of the donor. In terms of fund allocation, American higher education research institutions and organizations usually allocate funds according to the nature, scale and quality of research projects. Generally speaking, excellent research projects will receive more financial support so that they can better promote scientific research and technological development. In addition, higher education research institutions and organizations in the United States usually allocate funds according to the commercialization of research results, social impact and other factors.

## **2.3 Mechanism of transformation and industrialization of scientific and technological achievements**

The transformation and industrialization mechanism of scientific and technological achievements in American higher education is a complete set of mechanisms, which aims to transform scientific and technological achievements into commercial products and services, and make contributions to economic development and social progress. American higher education institutions and research institutes usually convert their scientific and technological achievements into commercial products and services in the form of authorization, licensing, and establishment of enterprises. Technology transfer is a form of transformation of scientific and technological achievements. Some universities and research institutes will also set up technology transfer offices to manage and promote the transformation of scientific and technological achievements. Technology transfer can promote the commercial application and industrial development of scientific and technological achievements, and also help higher education institutions obtain more income. American higher education institutions and research institutes usually provide entrepreneurial support to help entrepreneurs transform scientific and technological achievements into commercial products and services. Entrepreneurial support includes providing venues, funds, mentors and network resources to help entrepreneurs succeed in entrepreneurship. American higher education institutions and research institutes usually set up investment funds for the commercial development of start-ups and scientific and technological achievements. Investment funds can provide capital and resource support for start-ups, and also help higher education institutions obtain more income. The U. S. government usually issues policies to support the transformation and industrialization of scientific and technological achievements of higher education institutions and research institutes, including tax relief, incentives, venture funds, etc., to encourage the commercialization and industrialization of scientific and technological achievements.

## **2.4 Innovative talent training mechanism**

The cultivation mechanism of innovative talents in American higher education mainly includes diversified education system, innovative research and project support, independently selected courses and learning plans,

emphasis on practice and experimental education, and the education mode of teacher – student interaction. American higher education system is diversified, including research universities, colleges of arts and sciences, community universities and different types of higher education institutions with own characteristics and advantages. Such a diversified education system can meet the needs and development directions of different students, and promote the cultivation of innovative talents. American higher education institutions usually support students' participation in innovative research and projects. Students can master innovative methods and practical experience, and cultivate the ability and quality of innovative talents by participating in scientific research projects, entrepreneurship competitions, innovation and entrepreneurship centers, etc. American higher education emphasizes students' independent choice and design of learning plans, and encourages them to explore their own interests and potential. This can cultivate students' ability in innovative thinking and autonomous learning, and help them become talents with innovative spirit and entrepreneurial consciousness. American higher education attaches great importance to practical and experimental education, and encourages students to explore and apply knowledge in practice. Students can participate in real – world problem – solving and innovative practice through laboratories, internships, curriculum projects and other ways, so as to cultivate the ability and quality of innovative talents. American higher education emphasizes the educational mode of teacher – student interaction and encourages exchanges and cooperation between students and teachers. Teachers will pay attention to cultivating students' thinking ability and innovative consciousness in teaching, and also provide students with mentors and career guidance to help them achieve their development goals.

### **3 Enlightenment of research and innovation mechanism of American higher education to China**

The successful experience of research and innovation mechanism of American higher education provides reference and enlightenment for research and innovation of China's higher education. We should strengthen the reference and constantly improve the mechanism system construction for research and innovation of higher education. First, increase investment in scientific research and optimize the allocation mechanism of scientific research funds. The success of research and innovation mechanism in American higher education benefits from a large amount of scientific research investment from the state and the private sector, as well as the optimized allocation mechanism of scientific research funds. China should increase scientific research investment, strengthen policy guidance, adjust the allocation mechanism of scientific research funds, encourage the participation of enterprises and all sectors of society, and improve the efficiency of scientific research funds. Second, establish a collaborative innovation mechanism. The scientific research and innovation mechanism of higher education in the United States attaches importance to collaborative innovation between different fields and institutions, and promotes the sharing and transformation of scientific research achievements. China should strengthen the cooperation among industry, university and research, strengthen collaborative innovation at home and abroad, and build a platform for the sharing and transformation of scientific research achievements. Third, cultivate high – level talents. The scientific research and innovation mechanism of higher education in the United States focuses on cultivating high – level talents with innovative consciousness and practical ability to inject new vitality to scientific and technological innovation. China should pay attention to cultivating high – level talents with international competitiveness, improve the quality of talent training, strengthen the cultivation of practical ability, and improve the ability of innovation and entrepreneurship. Fourth, promote the transformation and industrialization of scientific and technological achievements. The scientific research and innovation mechanism of American higher education pays attention to the transformation and industrialization of scientific and technological achievements, and emphasizes the practical application and commercialization of scientific and technological achievements. China should strengthen the transformation and industrialization of scientific and technological achievements, actively promote their application in economic and social development, and improve their market and economic benefits. Fourth, strengthen the protection of intellectual property rights. The research and innovation mechanism of American higher education pays attention to the protection of intellectual property rights, and strengthens the protection and application of them. China should follow suit, and effectively protect the legitimate rights and interests of intellectual property rights.

## **4 The present situation and problems of scientific research and innovation mechanism of higher education in China**

### **4.1 Insufficient investment and management of scientific research funds**

The problems of insufficient investment and management of scientific research funds in China's higher education are mainly manifested in the following aspects: First, the overall scale of scientific research funds is relatively small. Compared with the United States and other developed countries, Chinese government's investment in higher education research is small, which is difficult to meet the needs of higher education research. Second, the allocation of scientific research funds is unreasonable. At present, the allocation of scientific research funds for higher education in China is not fair and scientific. Most of the funds are concentrated in a few famous universities and key disciplines, while some ordinary universities and schools in the central and western regions are facing the problem of lack of funds. Third, the management of scientific research funds is not standardized. In China, the management of scientific research funds in some universities and scientific research institutions is not standardized, and there are problems such as misappropriation and waste of funds, which lead to the ineffective transformation of scientific research achievements.

### **4.2 The distribution and structure of academic institutions are unreasonable**

The unreasonable distribution and structure of academic institutions in China's higher education are mainly manifested in the following aspects: First, the geographical distribution of academic institutions is uneven. Some high-level academic institutions are mainly concentrated in first-tier cities and coastal areas, while relatively few academic institutions in the central and western regions. This has led to the uneven distribution of scientific research resources and the inadequate utilization of scientific research achievements. Second, the types and structures of academic institutions are not diversified enough. The type and structure of academic institutions of higher education in China are relatively single, most of which are comprehensive universities, and there is a relatively small number of professional academic institutions. This makes the depth and breadth of some research fields unable to be fully explored and displayed. Third, there is a lack of effective cooperation mechanism between academic institutions. In China, some universities and scientific research institutions lack an effective cooperation mechanism and cannot form a benign competition and coordination mechanism, which leads to the waste of scientific research resources and the underutilization of academic achievements.

### **4.3 The degree of transformation and industrialization of scientific research achievements is low**

The degree of transformation and industrialization of scientific research achievements in China's higher education is relatively low. There are the following problems: First, the evaluation system of scientific research achievements is not perfect. The current scientific research evaluation system mainly focuses on the publication of papers and the acquisition of scientific research funds, while the evaluation of the transformation of scientific research achievements and the contribution of industrialization is less. Second, the lack of industry-university-research cooperation mechanism. The cooperation between Chinese universities and enterprises is relatively small, and the lack of effective technology transfer and industrialization cooperation mechanism leads to the failure of effective application of scientific research achievements. Third, the lack of protection mechanism for intellectual property. The lack of intellectual property protection is one of the main bottlenecks restricting the industrialization of scientific research achievements. China's laws, regulations and law enforcement efforts in intellectual property protection still need to be further strengthened. Fourth, lack of innovation consciousness. Some universities and scientific research institutions have the thinking inertia of "facing political achievements" and "paying attention to Academic Ranking", ignoring the importance of scientific and technological innovation, resulting in the difficulty of converting scientific research achievements into practical applications and economic benefits.

### **4.4 The training system of innovative talents is not perfect**

There are the following deficiencies in the cultivation system of innovative talents in China's higher education: First, the curriculum does not meet the needs. At present, the professional curriculum offered by some colleges and universities is relatively traditional, which is out of line with the market demand and industrial development trend, and fails to meet the training needs of innovative talents. Second, the teaching method is single. The traditional

classroom teaching mode has been unable to meet the learning needs of students, so we should adopt more flexible and diversified teaching methods, such as project-based teaching, practical teaching, etc., in order to cultivate students' practical ability and innovative thinking ability. Third, lack of international vision. The current level of internationalization needs to be improved. Students' international literacy and global vision are relatively weak, which may have a certain impact on future career planning and development. Fourth, the career planning is not perfect. The career planning mechanism of some schools is not perfect enough to provide effective career guidance and employment support, leading to the loss of some innovative talents or failing to give full play to their strengths.

## **5 Thoughts and suggestions on the development of scientific research and innovation mechanism of higher education in China**

With the rapid development of China's economy and the continuous improvement of the level of higher education, scientific research and innovation of higher education have become one of the key areas of China's development. However, there are many problems in scientific research and innovation of higher education in China, such as insufficient investment and management of scientific research funds, unreasonable distribution and structure of academic institutions, low degree of transformation and industrialization of scientific research achievements, and imperfect cultivation system of innovative talents. Therefore, we need to take a series of measures to promote the development of scientific research and innovation mechanism of higher education in China.

### **5.1 Increase investment in scientific research and management**

The lack of investment and management of scientific research funds in China's higher education is one of the main problems restricting the development of scientific research and innovation. In order to solve this problem, the following measures can be taken: First, increase investment. The government should increase investment in scientific research of higher education, improve the financial support of scientific research projects, and provide more adequate financial support for scientific research activities of higher education. Second, improve fund management. We should improve the management mechanism of scientific research funds for higher education, establish a scientific and reasonable fund management system and financial audit system, strengthen the supervision and audit of scientific research funds, and improve the efficiency and fairness of the use of funds. Third, guide the participation of social capital. Encourage social capital to participate in higher education research activities, attract social capital to participate in higher education research and innovation through the establishment of science and technology funds, science and technology innovation bases and other forms, and promote the transformation and industrialization of scientific and technological achievements. Fourth, improve the treatment of scientific researchers. We will increase support for the salaries and benefits of researchers in higher education, improve the treatment and incentive mechanism for researchers, and attract more outstanding talents to participate in the research and innovation of higher education.

### **5.2 Optimize the distribution and structure of academic institutions**

To optimize the distribution and structure of academic institutions of higher education in China, we need to fully cooperate among colleges and universities, adjust the layout of disciplines, improve the academic level, and introduce and cultivate excellent academic talents. Only through continuous reform and innovation can we promote the healthy development of higher education and further enhance the international competitiveness of China's higher education. For China's higher education, the distribution and structure of academic institutions can be optimized from the following aspects: First, strengthen cooperation and resource sharing among colleges and universities. Optimizing the distribution of academic institutions requires full cooperation and resource sharing among colleges and universities to avoid repeated construction and waste of resources. At the same time, it is also necessary to give full play to the characteristics and advantages of colleges and universities. They can work together in research fields and disciplines to form a reasonable academic pattern. Second, adjust the discipline structure of colleges and universities. At present, there are some problems in the discipline structure of colleges and universities in China. Some disciplines are over-constructed, while others are relatively weak. Therefore, we need to deepen the discipline evaluation, adjust the discipline layout and other measures to promote the balanced development of disciplines and optimize the discipline structure of colleges and universities. Third, improve the academic level of

colleges and universities. The improvement of academic level in colleges and universities is the key to optimize the distribution and structure of academic institutions. Colleges and universities can continuously improve their academic influence and status by improving the teaching staff, improving the level of scientific research, and strengthening academic exchanges, so as to drive the development of the whole academic institution. Fourth, introduce and cultivate excellent academic talents. The key to optimizing the distribution and structure of academic institutions in higher education lies in talents. Therefore, it is necessary for colleges and universities to strengthen the introduction and training of talents and improve the overall quality and level of college teachers. At the same time, it is also necessary to strengthen the attraction and retention of excellent academic talents, encourage them to play an important role in colleges and universities, and promote the development of academic institutions.

### **5.3 Improve the mechanism for the transformation and industrialization of scientific and technological achievements**

There are still some problems in the transformation and industrialization of scientific and technological achievements in China's higher education, such as imperfect government management system, underdeveloped institutions for patent technology transfer, and imperfect evaluation system of scientific and technological achievements. Therefore, in order to improve the transformation and industrialization mechanism of scientific and technological achievements in China's higher education, the following measures can be taken: First, improve the government management system. A nationwide management organization for the transformation and industrialization of scientific and technological achievements can be established to strengthen its regulatory functions, and standardize and guide the transformation and industrialization of scientific and technological achievements in universities and scientific research institutions. Second, establish specialized technology transfer institutions. Specialized technology transfer institutions can be established to improve the evaluation and incentive mechanisms, and the service quality and transformation efficiency of technology transfer institutions. Third, improve the evaluation system of scientific and technological achievements. We should establish an evaluation system for scientific and technological achievements, give full play to its incentive role, strengthen the evaluation and management of scientific and technological achievements, and improve the efficiency of the transformation and industrialization of scientific and technological achievements. Fourth, promote industry – university – research cooperation. Strengthen the cooperation between universities and enterprises, apply scientific research achievements directly to the production and business activities of enterprises, promote the cooperation between industry, university and research, and realize the transformation and industrialization of scientific and technological achievements. Through the above measures, we can promote the transformation and industrialization of scientific and technological achievements in China's higher education, and improve the social services and economic benefits of colleges and universities. At the same time, they can promote industrial upgrading and transformation, and improve the country's economic strength and competitiveness.

### **5.4 Establish an innovation-and entrepreneurship-oriented talent training system**

In order to establish an innovation-and entrepreneurship-oriented talent training system in China's higher education, the following measures need to be taken: First, promote curriculum reform and strengthen innovation education. According to different majors and levels of students, innovative and practical courses are set up to enhance students' innovative consciousness and practical ability. Second, improve teaching methods and teaching quality. Adopt diversified teaching methods, such as case teaching, flipped classroom, etc., to encourage students to think independently, cooperate and explore, and cultivate innovation and entrepreneurship ability. Third, strengthen practical teaching and improve students' practical ability. Establish practical teaching platforms for practice, training, experiment and scientific research, so that students can contact practical problems and master the methods and skills to solve them. Fifth, strengthen the cultivation of students' awareness and ability of innovation and entrepreneurship. Set up innovation and entrepreneurship clubs, and science and technology forums to provide entrepreneurship counseling and practice opportunities, and stimulate students' enthusiasm and ability for innovation and entrepreneurship. Fifth, strengthen the construction of teaching staff and improve the quality of teachers. Strengthen the training and evaluation of teachers' innovation and entrepreneurship, improve their

innovation and entrepreneurship level, and provide support for students' innovation and entrepreneurship education. Through the above measures, China's higher education can establish an innovation – and entrepreneurship-oriented talent training system to provide strong talent support for the country's innovation and development.

## 6 Conclusion

To sum up, the scientific research and innovation mechanism of higher education in the United States has provided a lot of enlightenment for the development of higher education in China, including: improving the investment and management level of scientific research funds, establishing a fair and transparent mechanism for the distribution of scientific research funds, and encouraging universities and scientific research institutions to actively strive for funding for various scientific research projects. Besides, the distribution and structure of academic institutions should be optimized to give full play to the strengths and advantages of different types of universities and scientific research institutions, strengthen exchanges and cooperation between different disciplines, and promote academic intersection and integration; the mechanism of transformation and industrialization of scientific and technological achievements should be improved to encourage universities and scientific research institutions to cooperate closely with enterprises, improve the efficiency and quality of transformation of scientific and technological achievements, and promote the rapid transformation of scientific and technological innovation into the economy and society; an innovation-and entrepreneurship-oriented talent training system should be established to pay attention to the cultivation of high – level innovative talents with practical ability, innovative spirit and international vision, and promote the close connection between higher education and industrial demand; open innovation should be promoted to strengthen academic exchanges and cooperation, encourage scientists and scholars to cooperate across national boundaries, and improve the internationalization level of scientific and technological innovation; the market mechanism should be introduced to establish the scientific research performance evaluation system, encourage universities and scientific research institutions to compete and innovate, and stimulate the enthusiasm and vitality of innovation and entrepreneurship.

China's higher education is an important part of China's education system, which provides important support and impetus for the country's economic development and social progress. However, in terms of scientific research and innovation, there are still some problems in China's higher education, such as insufficient investment and management of scientific research funds, unreasonable distribution and structure of academic institutions, low degree of transformation and industrialization of scientific and technological achievements, and imperfect cultivation system of innovative talents. Therefore, China's higher education can strengthen its learning and reference of the scientific research and innovation mechanism of American higher education, constantly improve its own scientific research and innovation mechanism, and systematically promote itself from many aspects, so as to meet the demand of modern society for high-quality talents, effectively promote the rapid development of China's higher education and realize the great rejuvenation of the Chinese dream.

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