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## Serving National Strategic Needs, Cultivating Top-Notch Innovative Talents: Institutional Logic and Development Practices of Research-Education Integration at the University of Chinese Academy of Sciences (Postprint)

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### Abstract

The report of the 20th National Congress of the Communist Party of China dedicated a special chapter to “Implementing the Strategy of Revitalizing the Country through Science and Education and Strengthening Talent Support for Modernization,” particularly emphasizing that “Education, science and technology, and talent are the foundational and strategic supports for comprehensively building a modern socialist country.” The integration of science and education constitutes a crucial pathway for achieving the integrated development of education, science and technology, and talent. This article traces the origins and development of the integration of science and education, analyzes three specific manifestations of inter-organizational integration of science and education worldwide, reviews the developmental trajectory, institutional logic, and principal characteristics of the University of Chinese Academy of Sciences in cultivating high-level innovative talents through the integration of science and education since China’s reform and opening up, and finally provides an outlook on the future of cultivating top-notch innovative talents through the integration of science and education at the University of Chinese Academy of Sciences.

## Full Text

### **Serving National Strategic Needs, Cultivating Top Innovative Talents—Institutional Logic and Developing Practice of University of Chinese Academy of Sciences in Running Integration of Scientific Research and Education**

The report of the 20th National Congress of the Communist Party of China designated “Implementing the Strategy of Revitalizing China through Science and Education, Strengthening Talent Support for Modernization” as a dedicated chapter, emphasizing that “Education, science and technology, and human resources are the foundational and strategic pillars for comprehensively building a modern socialist country.” The integration of research and education represents a crucial pathway toward the integrated development of education, technology, and talent. This article traces the origins and evolution of research-education integration, analyzes three specific manifestations of cross-organizational research-education integration worldwide, reviews the developmental trajectory, institutional logic, and main characteristics of the University of Chinese Academy of Sciences (UCAS) in cultivating high-level innovative talents through research-education integration since China’s reform and opening up, and finally prospects the future of UCAS in nurturing top innovative talents through this model.

**Keywords:** University of Chinese Academy of Sciences (UCAS); integration of research and education; talent cultivation; institutional logic

#### **The Origin and Development of Research-Education Integration**

In the early 19th century, German educator Wilhelm von Humboldt established the University of Berlin, introducing scientific research into the university and transforming it into an academic organization integrating knowledge innovation and talent cultivation. In the late 19th century, Daniel Coit Gilman, president of Johns Hopkins University, institutionalized the integration of research and education in graduate training by establishing graduate schools. Beginning during World War II, the U.S. federal government’s large-scale funding of university research greatly promoted the development of internal research-education integration systems in research universities. Since the 19th century, responding to scientific and technological trends and national strategic needs, traditional university concepts and models have continuously innovated, deepening the principle of “unity of research and teaching.” While producing research outcomes, substantive national research institutions have continuously strengthened their talent cultivation functions, achieving sustainable talent development through coordinated development and mutual empowerment among education, science and technology, and human resources.

Currently, changes in knowledge production modes and the high coupling between scientific and technological innovation and talent cultivation have accelerated the trend of research-education integration globally. Cross-organizational

research-education integration between national research institutions and universities manifests in three specific forms. First, the U.S. embedded model features collaboration between national laboratories and host universities. During World War II, the U.S. federal government funded the establishment of national laboratories such as MIT's Radiation Laboratory, Argonne Laboratory at the University of Chicago, and Los Alamos and Lawrence Laboratories at the University of California. After the war, to ensure healthy development of these laboratories, the federal government entrusted them to high-level research universities through hosting contracts specifying mutual responsibilities. This characterizes the government-owned, contractor-operated (GOCO) national laboratories and represents an important feature of U.S. research university development.

Second, the collaborative model represented by Germany and France involves national research institutions and universities jointly training graduate students. To meet innovation development needs, France enacted the Research Programming Law (2006) and the Higher Education and Research Law (2013), strengthening strategic reorganization of research institutions and universities. Germany implemented the Excellence Initiative starting in 2006, supporting universities and research institutions to establish "clusters" that encourage collaborative innovation and common development. Russia launched its "2021–2030 Academic Leadership Strategy" in 2021, concentrating superior resources to integrate and reorganize universities and research institutions under different ministries to provide scientific, technological, and talent support for achieving Russia's 2030 national development goals.

Third, the integration model represented by China features cross-organizational research-education integration within the same system, with the Chinese Academy of Sciences (CAS) being most typical. As a national research institution, CAS listed "training and rational allocation of scientific research personnel" as one of its three fundamental tasks at its founding, pioneering graduate education systems and establishing the University of Science and Technology of China (USTC) and China's first graduate school. In 2011, CAS issued the "CAS Education Development Strategy and Roadmap (2010–2050)," proposing the education development policy of "integration of research and education, coordinated development, highlighting characteristics, and leading by example" under the "trinity" development framework of research institutes, academic divisions, and educational institutions, continuously deepening research-education integration mechanisms. This model emphasizes leveraging the organizational advantages of national research institutions in mobilizing large missions, platforms, and teams for rapid assembly, close cooperation, and collaborative 攻关, closely linking talent cultivation with national planning and major scientific and technological tasks. While ensuring completion of major missions, it has cultivated large numbers of scientific and technological innovation talents, forming the tradition of "using missions to drive disciplines and using disciplines to promote missions" and the education model of "cultivating high-quality high-level innovative talents in high-level research practice, and

supporting high-level research with high-quality high-level innovative talents.”

### **The Development History and Institutional Logic of UCAS’s Research-Education Integration**

UCAS’s practice in research-education integration can be traced back to 1951 when CAS and the Ministry of Education jointly issued the “1951 Summer Recruitment Measures for Research Interns and Graduate Students,” initiating high-level talent cultivation. In 1958, USTC was established with the guiding principle of “the whole Academy runs the university, with institutes and departments combined.” In 1978, approved by the Party Central Committee and the State Council, CAS pioneered the establishment of a graduate school (later renamed UCAS), advancing the talent cultivation system from research-education combination to integration through an institutionalized system.

**Establishing an Institute-Based Training System with Graduate Schools as Teaching Support** In September 1977, as China embarked on reform and opening up and ushered in the “spring of science,” CAS submitted a report to the State Council proposing to resume graduate admissions and explore graduate degree systems to address the urgent need for scientific talent in the “Four Modernizations” construction. In November 1977, CAS and the Ministry of Education jointly issued the “Notice on Specific Measures for Graduate Admissions in 1977,” restoring graduate education after a 12-year interruption. In March 1978, the State Council approved the establishment of the Graduate School of USTC, with Yan Jici as president, marking an important milestone in China’s graduate education restoration. CAS’s graduate training implemented the whole Academy running the university, with institutes as training entities and graduate schools providing teaching support.

The advanced research platforms, cutting-edge research projects, and high-level innovation teams of CAS institutes provided first-class environments and resources for graduate training. Graduate schools established systematic graduate course systems, with top scientists participating in curriculum development and teaching, integrating frontier scientific and technological achievements into classrooms. This model balanced the concentrated teaching advantages of graduate schools with the research advantages of institutes, forming a unique talent cultivation system that leveraged the “spillover” effect of research-education integration and trained large numbers of high-level talents active in China’s science and technology, education, economy, and defense sectors, making pioneering and leading contributions to China’s scientific and educational development.

**Renaming and Establishing the “Three Unifications, Four Combinations” Policy** On the eve of the 21st century, as the world entered the knowledge economy era, science and technology played increasingly prominent roles in economic development. The ability to create and apply knowledge became a decisive factor affecting national comprehensive strength and international com-

petitiveness. China needed to transform its traditional economic growth model, accelerate industrial upgrading, and achieve sustainable development, requiring its scientific research to shift from following and imitation to original innovation. In response, the Party Central Committee decided to accelerate construction of a national innovation system oriented toward the knowledge economy. In 1998, to implement this major strategic decision, CAS comprehensively launched the pilot work of the “Knowledge Innovation Program,” with graduate education reform as an important component.

Faced with the fragmentation of education caused by CAS institutes’ cross-regional, distributed, and multi-legal-person structure, building a unified graduate education management system became urgent. At the CAS Education Work Conference in June 2000, CAS outlined its educational blueprint for the 21st century. To meet the needs of the strategy of revitalizing China through science and education and the “Knowledge Innovation Program,” address problems in dispersed graduate training, and improve talent cultivation quality, CAS implemented graduate education system reform—renaming and reorganizing the Graduate School of USTC (Beijing) into the University of Chinese Academy of Sciences by integrating graduate education resources dispersed across more than 100 institutes. The renamed UCAS consisted of three teaching campuses in Beijing, five education bases outside Beijing, and over 100 graduate training units nationwide.

Following the “Three Unifications, Four Combinations” policy, UCAS implemented “unified enrollment, unified education management, and unified degree conferral” and “combined institute-school leadership system, combined faculty, combined management system, and combined training system.” This reform promoted major changes in the graduate school management system and facilitated standardized, high-level development of CAS graduate education. In 2012, approved by the Ministry of Education, the Graduate School of CAS was officially renamed UCAS. After renaming, UCAS further deepened and established its educational philosophy of “integration of research and education, talent cultivation as the foundation, collaborative innovation, and serving the nation,” continuously innovating systems and mechanisms, creating and improving a quality assurance system for graduate enrollment, training, and education throughout the entire process, and opening a new chapter in the scientific development of CAS’s educational undertakings, providing a model for developing and perfecting the research institution graduate education system in China.

**Deepening System Reform and Establishing Research-Education Integration Colleges** On July 17, 2013, during his inspection of CAS, General Secretary Xi Jinping pointed out that CAS must remember its responsibilities, take the lead in achieving scientific and technological leapfrog development, building a national highland of innovative talent, building a national high-level science and technology think tank, and building a world-class scientific research institution. He urged CAS to continue leveraging its characteristics and ad-

vantages in cultivating talent through close integration with research practice, gather first-class talent from home and abroad, cultivate world-class science masters, nurture high-quality scientific and technological innovation and entrepreneurship talents, and build CAS into a great school gathering masters and producing outstanding talents. This speech not only pointed out the direction for CAS development in the new era but also provided fundamental guidance for UCAS to further deepen research-education integration system innovation and cultivate scientific and technological innovation talent.

Colleges and departments constitute the basic framework of university operation. In October 2014, according to CAS's overall deployment, UCAS comprehensively launched the construction of research-education integration organizations. In January 2015, the first college established under this system—the School of Physical Sciences—was formally founded. The school is primarily hosted by the Institute of Physics, CAS, with co-hosting by the Institute of Theoretical Physics, Institute of High Energy Physics, Institute of Semiconductors, Institute of Acoustics, and more than ten other physics-related institutes outside Beijing participating in its construction. Relying on CAS institutes, UCAS has successively established 40 research-education integration colleges and 339 teaching and research sections, forming a system that achieves substantive integration with CAS-affiliated research institutions in management systems, faculty, training systems, and research work.

Through the college model, UCAS has transformed the rich research resources of institutes into educational resources, creating synergistic advantages and establishing an efficient mechanism for integrating, co-constructing, co-governing, and sharing research-education resources. This has strengthened the education and talent cultivation quality assurance system. As an organic component of the new research-education integration college system, UCAS implemented a full-time faculty system, selecting and employing researchers with high academic levels and strong teaching abilities to participate in teaching, forming a high-level faculty team including over 3,000 full-time teachers and nearly 13,000 graduate supervisors, among whom nearly 300 are academicians of the Chinese Academy of Sciences and Chinese Academy of Engineering. To create an academic atmosphere pursuing excellence and an educational environment where top innovative talents can stand out, UCAS established an academic honors and tenure system. To cultivate future talent echelons, it launched the Special Research Assistant Program. Through these talent system reforms, UCAS assembled a first-class research-education integration faculty team, making “research-education integration” a distinctive feature of its educational model.

In 2014, UCAS began enrolling undergraduate students, forming a higher education system covering undergraduate, master's, and doctoral levels with graduate education as the main body. Consequently, UCAS began exploring a new model of continuous, long-cycle cultivation of top innovative talent. Undergraduate education adheres to the development approach of “small but excellent, unique and strong,” fully leveraging the advantages of the research-education

integration model. The university implements a full-process academic mentorship system, carefully selecting outstanding scientists including academicians and “National Science Fund for Distinguished Young Scholars” recipients as academic mentors for each undergraduate student. Students can choose laboratories according to their interests and participate in research practice, achieving high-level personalized cultivation. Following the laws of knowledge systems and talent development, UCAS implements a “three-stage” training approach: the first stage focuses on general education courses, selecting and determining the most interesting major under academic mentor guidance; the second stage emphasizes foundational professional courses to consolidate professional foundations; the third stage involves overseas study visits and completing graduation projects in institutes, applying learned knowledge to research practice. This approach effectively cultivates top innovative talents with high research aspirations, broad knowledge 口径, solid foundations, broad vision, strong capabilities, and great potential. In 2016, UCAS undergraduate education was included in the Ministry of Education’s “Everest Plan,” with undergraduate advancement rates continuously exceeding 90%.

### **Main Characteristics of UCAS’s Research-Education Integration Model**

After more than 40 years of exploration and practice, UCAS has achieved substantive integration with CAS-affiliated research institutions in management systems, faculty, and training systems. In transforming CAS’s advanced research platforms, cutting-edge research projects, and world-class faculty into talent cultivation advantages, UCAS has formed a distinctive research-education integration model with prominent features.

### **Unique Organizational Structure for Research-Education Integration**

UCAS, built upon CAS’s institutionalized research strength, can not only leverage the powerful scientific and technological innovation advantages of CAS research institutes but also possesses conditions to explore research-education integration at deeper institutional and systemic levels. The university’s degree evaluation committees, academic committees, teaching committees, and college deans are composed of research-education integration full-time faculty and graduate supervisors with rich talent cultivation and research-education management experience, playing important roles in academic leadership, degree evaluation, teaching guidance, and discipline construction.

Research-education integration colleges are the hub of UCAS’s strategy. Colleges are primarily hosted and co-hosted by multiple high-level CAS institutes. As “education units,” colleges integrate with the quality research-education resources of multiple hosting institute “innovation units,” establishing teaching and research sections in the strongest laboratories. College deans are concurrently held by hosting institute legal representatives or academicians and senior scientists. This series of important measures and organizational transforma-

tions maximally stimulates and enhances institutes' autonomy and enthusiasm in participating in education. Through this college model, UCAS has established an efficient mechanism for integrating and sharing research-education resources, strengthening education and talent cultivation quality assurance systems. UCAS's colleges and discipline systems are no longer traditional hierarchical structures but knowledge logic-linked systems.

### **High-Level Scientist-Based Research-Education Integration Faculty**

Leveraging its research-education integration advantages, UCAS selects CAS's highest quality educational resources to build a high-level faculty team composed of full-time teachers and graduate supervisors. By implementing the "Position Teacher" system, numerous high-level scientists from various institutes who love education have taken up teaching positions, elevating the faculty's caliber. Academicians of the two academies, chief scientists of major national research projects, and key laboratory directors teach as course leaders or team members, bringing their wisdom and frontier scientific progress into classrooms, enabling students to stand at the forefront of scientific research. Scientists serving as academic mentors and teachers not only deeply understand the internal connections among "research-teaching-learning-innovation" but also effectively help students achieve organic integration among "disciplinary theory, frontier progress, research practice, scientific spirit, and patriotism"—a foundational advantage of UCAS's research-education integration education.

Additionally, UCAS implements a mentor responsibility system in research-education integration, perfecting faculty development institutions and mechanisms, including standardizing mentor selection procedures, strictly reviewing mentor qualifications annually, establishing dynamic adjustment mechanisms for mentor positions and enrollment quotas, revising graduate supervisor work regulations to strengthen position responsibility, enhancing professional ethics construction to foster virtue cultivation, and establishing a people-oriented institutional incentive system to stimulate individual innovation vitality.

### **Adhering to "Three Orientations" and "Four Leads," Driving Discipline Construction Through Major Missions**

Discipline construction forms the foundation and vehicle for talent cultivation. Discipline development relies on scientific research support and promotion. As the main force of national strategic scientific and technological strength, CAS has undertaken major missions from "Two Bombs, One Satellite" to the Beijing Electron-Positron Collider and the "China Sky Eye" (FAST), exploring the universe from the smallest particles to the largest cosmos. In fulfilling these sacred missions, CAS has gradually developed a path and model of organized research driving discipline development through "using missions to drive disciplines and using disciplines to promote missions," explicitly proposing the "Three Orientations" (oriented toward world science and technology frontiers, oriented toward major national needs, oriented toward the main economic battlefield) and "Four Leads" (leading in achieving scientific and technological leapfrog development,

leading in building a national highland of innovative talent, leading in building a national high-level science and technology think tank, leading in building an international first-class scientific research institution) development guidelines.

UCAS's discipline layout aligns with CAS's discipline layout. Following the "Three Orientations" and "Four Leads" requirements, UCAS deploys key scientific and technological fields and major strategic tasks, linking comprehensively with CAS's strategic deployment in program setup, discipline types, hierarchical structure, and regional distribution. On one hand, building upon CAS's historical accumulation, UCAS focuses on developing basic disciplines in natural sciences including mathematics, physics, chemistry, biology, astronomy, geography, geology, and geophysics with distinctive advantages. On the other hand, it strengthens frontier interdisciplinary, emerging, and comprehensive disciplines, establishing specialties such as cyberspace security, planetary science, integrated circuit science and engineering, nanoscience and engineering, basic medicine, and regenerative medicine to meet national economic and social development needs. Through strategic integration of university-institute research-education resources, UCAS has established a batch of interdisciplinary research-education integration colleges such as the Future Technology College. Under this institutional design, UCAS's colleges and discipline systems maximize the motivation and enhancement of institutes' educational autonomy and enthusiasm.

**Educational Advantages and International Impact of the Research-Education Integration Model** Based on the cultivation laws of high-level scientific and technological innovation talents, UCAS has formed a university governance system, education development system, talent cultivation system, and scientific and technological innovation system characterized by research-education integration. It has cultivated scientific and technological reserve forces on a large scale and in an institutionalized manner, contributing a highly valuable scientific and technological innovation talent cultivation model and exploring a new path toward building a world-class university with Chinese characteristics. Over its 45-year history, UCAS has trained more than 210,000 doctoral and master's students and 1,724 bachelor's students, including China's first doctor of science, first doctor of engineering, first female doctor, and first dual-degree doctor. UCAS graduates account for approximately one-quarter of all "National Science Fund for Distinguished Young Scholars" recipients, with 161 alumni elected as academicians of the two academies. UCAS-trained scientific and technological innovation talents have actively participated in major national scientific and technological missions and frontier scientific explorations including the Beijing Electron-Positron Collider, Shanghai Synchrotron Radiation Facility, "China Sky Eye," "Artificial Sun" (EAST), LAMOST telescope, dark matter satellite "Wukong," X-ray astronomy satellite "Insight," iron-based superconductivity, neutrino oscillation patterns, quantum anomalous Hall effect, space gravitational wave detection "Taiji Program," and novel coronavirus vaccine development. This fully demonstrates the unique advantages and re-

markable effectiveness of UCAS's research-education integration system in cultivating high-level innovative talents, with its distinctive educational model gaining increasing recognition from domestic and international educational circles.

### Conclusion and Outlook

For a long time, as an important bearer of CAS's mission to "produce talent" and its goal to "take the lead in building a national highland of innovative talent," UCAS has actively advocated, practiced, and disseminated the concept and model of "research-education integration," promoting the implementation of the strategies of revitalizing China through science and education, innovation-driven development, and strengthening the nation with talented personnel. From establishing China's first graduate school at the beginning of reform and opening up to address the shortage of scientific and technological talent for economic recovery, to integrating and reorganizing scientific and educational resources in the 21st century to meet the opportunities and challenges of the knowledge economy and cultivate high-level talents for building an innovative country, and then to supporting the national innovation-driven development strategy in the new era by deepening the research-education integration system to explore new models for cultivating top innovative talents, UCAS has consistently responded to major national needs at different developmental stages, continuously exploring and reforming to improve talent cultivation quality and cultivating large numbers of scientific and technological leaders and innovative entrepreneurs for China's socialist modernization with Chinese characteristics.

The 20th Party Congress made integrated deployment for education, science and technology, and human resources. These are not separate functional modules but strategic units that mutually empower each other. Education is the foundation, science and technology are the core, and talent is the key. Facing the requirements of grasping the new development stage, implementing the new development philosophy, and building a new development pattern, UCAS will, guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, comprehensively implement the spirit of the 20th Party Congress, conscientiously implement work deployments of the Ministry of Education and CAS, persist in serving national strategic needs, continuously innovate systems and mechanisms, give full play to the leading role of high-level mentor teams and the platform role of major scientific and technological missions and infrastructure, adhere to using missions to drive disciplines and disciplines to promote missions, continuously transform research advantages into educational advantages, strengthen multi-subject collaborative innovation, cultivate high-level innovative talents with both moral integrity and professional competence, strive to build a world-class university with distinctive research-education integration characteristics, establish a national highland of innovative talent, and provide talent support for CAS to play its role as the main force of national strategic scientific and technological strength, making greater contributions to China's modernization drive.

## References

1. Zhou Guangli, Ma Haiquan. Integration of research and teaching and the modernization of university: The homogeneity and diversity of research system of western university. *China Higher Education Research*, 2013, (1): 12-21. (in Chinese)
2. Zhang Lei. The structural integration of science and education and the origin of research university—On the system innovation of Johns Hopkins University. *Journal of Higher Education*, 2016, 37(5): 79-86. (in Chinese)
3. Yang Jiubin. *Study on the United States Federal Government Research Funding Policy on Research Universities Scientific Research after World War*. Shanghai: East China Normal University, 2014. (in Chinese)
4. Zhang Wei. The evolution and hierarchical governance of integration between science and education. *Journal of Science, Technology and Education Studies*, 2023, 3(1): 43-63. (in Chinese)
5. Liu Ji'an, Sheng Xiaoguang. Dynamics, predicament and breakthrough of integration of research and education: A case study of the University of Chinese Academy of Sciences. *China Higher Education Research*, 2020, (11): 26-30. (in Chinese)
6. Jiao Lei, Xie Anbang. Study on the institutionalization foundation and organizational form innovation of interdisciplinary research in American research universities. *China Higher Education Research*, 2019, (1): 60-65. (in Chinese)
7. Hu Zhihui, Wang Jianfang, Zhang Qiuju. *A Study on Management Models of World's Major National Research Institutions*. Beijing: Science Press, 2016. (in Chinese)
8. Zhang Hui, Liu Baocun. The policy of creating the world-class university in France and its characteristics. *Journal of Higher Education*, 2015, 36(4): 89-96. (in Chinese)
9. Zhu Jiani. Promoting research excellence at universities: Implementation and trend of excellence initiative in Germany. *International and Comparative Education*, 2017, 39(2): 46-53. (in Chinese)
10. Zhang Mengqi. Motivation, path and system design of organizational change in French colleges and universities—Taking “university and institution community” as an example. *Higher Education Exploration*, 2017, (2): 72-80. (in Chinese)
11. Yuan Heng, Zhang Lijuan. Russia launches a new long-term plan for university development to promote the integration of science and education. *Scitech in China*, 2021, (12): 96-98. (in Chinese)
12. Yu Jianbin. The “Education Roadmap” of Chinese Academy of Sciences:

- Integrating science and education to cultivate future scientific talents. *The People's Daily*, 2011-02-21(20). (in Chinese)
13. Bai Chunli, Deng Yong. Serving the country, integration of science and education and cultivating the high-level innovative and entrepreneurial talents. *Guangming Daily*, 2009-09-27(10). (in Chinese)
  14. Zhang Xiaowei. Comprehension of “knowledge-based economy” implication. *Theoretical Front in Higher Education*, 1999, (4): 18-21. (in Chinese)
  15. Lu Yongxiang. Speech at the 60th anniversary meeting of the founding of Chinese Academy of Sciences. *Bulletin of Chinese Academy of Sciences*, 2009, 24(6): 578-584. (in Chinese)
  16. Zhang Li, Guo Jinhai, Xiong Weimin, et al. *Educational Development History of Chinese Academy of Sciences*. Beijing: Science Press, 2009. (in Chinese)

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