World Journal of Educational Research
ISSN 2375-9771 (Print) ISSN 2333-5998 (Online)
Vol. 12, No. 5, 2025
www.scholink.org/ojs/index.php/wjer

Original Paper

The Motivation, Practices, and Implications of Interdisciplinary Talent Cultivation in American Research Universities

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Fund Project

This paper is a phased achievement of the 2023 Youth Special Project under the "14th Five-Year Plan" of Beijing Municipal Education Science, entitled "Research on the 'Connection-Integration' Training Model for Top Innovative Talents in Finance and Economics Empowered by Digital Technology under the Background of New Liberal Arts Construction" (Project No.: CDCA23134).

Received: August 20, 2025 Accepted: September 29, 2025 Online Published: October 10, 2025

doi:10.22158/wjer.v12n5p135 URL: http://dx.doi.org/10.22158/wjer.v12n5p135

Abstract

Interdisciplinary talent cultivation has emerged as a key approach for research universities in light of evolving knowledge production methodologies and the rise of global complex issues. American research universities have constructed a mature cultivation system, driven by social requirements, policy guidance, and disciplinary regulations. This article analyzes its practices from four dimensions: strategic planning, organizational structure, cultivation model, and support system, that is, setting the direction through strategic layouts, breaking barriers with multiple organizations, realizing holistic cultivation through curriculum and research, and providing guarantees with multiple mechanisms. In response to the challenges faced by research universities in China, the article makes localized recommendations such as coordinated governance, curriculum reform, and improvement of support mechanisms, so as to provide references for cultivating interdisciplinary talents in the context of "Double First-Class" construction.

Keywords

American Research Universities, Interdisciplinary Talent Cultivation, Cultivation Model

1. Introduction

Driven by the transformation of knowledge production methods and the complexity of global issues, interdisciplinary talent cultivation has become a strategic core for research universities to respond to the demands of the times and enhance core competitiveness. After decades of exploration, American research universities have built a systematic, innovative, and operable interdisciplinary talent cultivation system. Their experiences in strategic planning, organizational structure, cultivation models, and supporting mechanisms provide significant reference value for optimizing the interdisciplinary talent cultivation system in China under the construction of "Double First-Class". This article takes American research universities as the research object, systematically analyzes the driving logic, practical paths, and guarantee mechanisms of their interdisciplinary talent cultivation, aiming to provide theoretical references and practical paradigms for the localized practice of interdisciplinary education in China.

2. Analysis of the Drivers for Interdisciplinary Talent Cultivation in American Research Universities

The rise and development of interdisciplinary talent cultivation in American research universities is not the result of a single factor but a dynamic evolutionary process driven by societal needs, policy guidance, and disciplinary laws. These three elements support and complement each other, jointly shaping the ecological foundation of interdisciplinary education.

2.1 Practical Demand for Interdisciplinary Collaboration in Addressing Complex Social Issues

The research report *"Facilitating Interdisciplinary Research"* (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine [NASEM], 2005) states that "Interdisciplinary research and education are driven by the need to solve complex problems that may arise from scientific curiosity or from social needs." The statement reveals the intrinsic connection between interdisciplinary education and social demands. Contemporary global challenges such as climate change governance, responses to major public health events, and the ethical regulation of artificial intelligence all exhibit "transdisciplinary" characteristics—their solutions cannot rely on the theories and methods of a single discipline but require the integration of knowledge systems from natural sciences, social sciences, and humanities (Nowotny et al., 2001). For instance, the integration of medicine, data science, and social governance was crucial in the control of the COVID-19 pandemic. Such practical demands directly prompted institutions such as Stanford University and MIT to incorporate interdisciplinary talent cultivation into their core missions (Sun et al., 2024).

2.2 Institutional Guidance through Policy Instruments

The U.S. federal government has provided institutional guarantees for interdisciplinary education through top-level design of research funding mechanisms, promoting a shift from "spontaneous exploration" to "systematic practice" in interdisciplinary talent cultivation. The "Integrative Graduate Education and Research Traineeship" (IGERT) program, launched by the U.S. National Science

Foundation (NSF) in 1997, used special funding to guide universities to break down traditional departmental barriers and integrate interdisciplinary thinking and methods into graduate cultivation. In 2014, IGERT was upgraded to the "NSF Research Traineeship" program (NRT), further focusing on interdisciplinary training in the fields of science, technology, engineering, and mathematics (STEM). It not only expanded the scope of funding but also encouraged universities to experiment with innovative educational models such as "project-based learning" and "interdisciplinary mentorship groups" (Peng et al., 2022), forming a linkage mechanism of "driving talent cultivation through research projects" and strengthening the practice-oriented nature of interdisciplinary education from a policy perspective.

2.3 Internal Drive from the Laws of Disciplinary Development

The "Mode 2" theory of knowledge production (Gibbons et al., 1994) points out that the creation of new knowledge is no longer limited to "pure academic research" within traditional disciplinary boundaries but increasingly relies on interdisciplinary collaboration in application scenarios—that is, the characteristics of "contextualization" and "problem-oriented" in knowledge production are becoming increasingly prominent (Gibbons et al., 1994). The theory aligns with the "synthesis-differentiation-re-synthesis" pattern of disciplinary development: when a single discipline develops to a certain stage, its theoretical boundaries and methodological limitations gradually emerge, and interdisciplinary zones often become new points of knowledge growth (Newell, 2007). For instance, the rise of emerging disciplines such as bioinformatics (the intersection of biology and computer science), computational social science (the intersection of sociology and data science), and environmental economics (the intersection of environmental science and economics) has created a rigid demand for talent with interdisciplinary knowledge structures. This internal logic of disciplinary development has prompted American research universities to proactively adjust their talent cultivation models to adapt to disciplinary evolution trends and ensure the synchronization of talent cultivation with the academic frontier.

3. Typical Practices of Interdisciplinary Talent Cultivation in American Research Universities

American research universities have constructed a comprehensive interdisciplinary talent cultivation system through a four-dimensional linkage of "strategic planning guidance—organizational structure innovation—cultivation model innovation—support system guarantee". Its core lies in breaking down traditional disciplinary barriers and forming a synergistic educational ecosystem.

3.1 Strategic Planning: Guiding Interdisciplinary Development with Long-term Layout

Research universities in the United States have integrated interdisciplinary talent cultivation into their medium- and long-term development strategies, clarifying development directions and resource allocation priorities through top-level design to avoid constraints imposed by the short-term perspectives of single disciplines on interdisciplinary education. From a national perspective, "*Facilitating Interdisciplinary Research*" (NASEM, 2005) provided a comprehensive strategic framework for the interdisciplinary development in universities from dimensions of policy formulation,

institutional collaboration, and resource investment. From the perspective of universities, Yale University listed mathematical foundation, data science, and quantum science as three key areas for interdisciplinary development in its 2018 "*Yale Science Strategy*", expanding the boundaries of students' knowledge through cross-departmental collaborative platforms (e.g., the Biological and Biomedical Sciences Graduate Platform). Johns Hopkins University has been incorporating interdisciplinary talent cultivation into its annual strategic progress reports over the past decade, highlighting faculty-led interdisciplinary course development and research projects (Peng et al., 2022). Duke University's interdisciplinary strategy demonstrates continuity—from "Crossing Boundaries: Interdisciplinary Planning for the Nineties" to the strategy update in 2017, the interdisciplinary nature has always been regarded as a core element of the university's "overall identity", forming a closed-loop system of "strategic planning—project implementation—dynamic evaluation—adjustment and optimization" (Jiao & Zhao, 2019).

3.2 Organizational Structure: Multiple Pathways to Break Disciplinary Barriers

The organizational approach to interdisciplinary graduate education in the United States primarily involves "establishing interdisciplinary graduate education programs to break down the organizational barriers between different disciplines and schools" (Welch-Devine et al., 2018). American research universities have addressed the challenge of disciplinary segmentation through diverse approaches, developing four typical pathways: independently established interdisciplinary research institutions, a coordinated model for graduate school, intra-school integration, and inter-school collaboration (Jiao, 2017).

Interdisciplinary research institutions focus on research while also considering talent cultivation. They build dedicated faculty teams through a full-time appointment system and deeply cultivate interdisciplinary fields over the long term. For example, the Center for Interdisciplinary Research and Graduate Education at the University of Tennessee at Knoxville focuses on the field of energy science and engineering. With independent personnel and financial authority, it ensures the stability of interdisciplinary research and cultivation, creating an "academic peak" effect (Jiao, 2017). MIT currently hosts over 60 cross-departmental academic institutions, most of which offer research positions to graduate students, achieving "integration of research and cultivation. (Zhu et al., 2015)" The graduate school plays a coordinating role by integrating resources from various schools and formulating unified training plans to ensure the smooth implementation of interdisciplinary programs. Intra-school integration refers to interdisciplinary graduate programs that are organized within a single school across its departments. It is easy to implement but the interdisciplinary scope is limited, and its influence is also confined, reflecting the innovation vitality at the grassroots level (Cheng et al., 2022). The "inter-school collaboration" model, such as the inter-school project of the School of Engineering at the University of Michigan, involves the joint appointment of teachers with other schools to cultivate interdisciplinary PhD students in applied physics (Jiao, 2017). Stanford University has 18 interdisciplinary laboratories and institutes, with multiple schools collaborating on 40 interdisciplinary

programs, including the Science, Technology, and Society program and the Human-Computer Interaction Program (Stanford University, n.d.). Inter-school collaboration has further expanded interdisciplinary boundaries. The "Health Sciences and Technology Program" (HST), jointly established by Harvard University and MIT, integrates resources from both universities in medicine, engineering, biology and other fields to cultivate talents with backgrounds in both medicine and engineering (Sun et al., 2024). These organizational forms do not exist in isolation but are complementary. For example, MIT has specifically appointed a Vice President and Provost responsible for coordinating various matters related to interdisciplinary education programs, forming a solid structure of "university-level leadership + school-level collaboration.(Zhu et al., 2015)"

3.3 Cultivation Model: Full-chain Integration from Curriculum to Research

American research universities construct a full-chain integration model for interdisciplinary talent cultivation through the combination of a "comprehensive and specialized curriculum system" and "immersive research training," achieving the coordinated promotion of "knowledge impartation—ability cultivation—literacy shaping."

In the construction of the curriculum system, interdisciplinary curricula follow the principles of "high integration, a balance between comprehensiveness and specialization, and problem orientation". Among them, "comprehensiveness" refers to the interdisciplinary degree or disciplinary breadth of course content, while "specialization" refers to the professionalism or depth of course content (Cheng et al., 2022). The interdisciplinary postgraduate program encourages students to "acquire comprehensive interdisciplinary knowledge through compulsory courses and specialize their understanding of different subjects through elective courses (Holley, 2009). As Holley noted, interdisciplinary courses should highly integrate multidisciplinary knowledge around common problems or research topics, establish connections between knowledge areas of various disciplines, and design tightly structured core courses and systematic elective courses to ensure that the knowledge students acquire is not fragmented (Holley, 2009). Layered curriculum design is an important practical form. For example, the PhD program in Energy Science and Engineering at the University of Tennessee sets up a three-tier system of core courses, breadth courses, and depth courses to achieve the three-dimensional construction of knowledge (Jiao, 2017). The Integrated Science (IS) program offered by Princeton University covers introductions to physics, chemistry, biology, and computer science, cultivating students' systems thinking through course integration (Princeton University, n.d.). Modular course combinations are also common. Stanford University's general education program includes four compulsory courses: Thinking and Behavior Methods, Effective Thinking, Writing and Rhetoric, and Foreign Languages, which reflects its emphasis on professional education without making it overly specialized, achieving a transformation from disciplines to abilities (Zhang & Liu, 2025). Collaborative curriculum teaching emphasizes teacher collaboration. Princeton University's "Humanistic Sequence (HUM)" is taught by a team of teachers from different departments, integrating multidisciplinary perspectives around the theme of Western culture. Research by scholars such as DI GIULIO has shown

that curriculum design that is “supportive (resource guarantee), connective (knowledge relevance) and participatory (student interaction)” can significantly enhance students' enthusiasm for participating in interdisciplinary learning (Di Giulio & Defila, 2017).

At the level of scientific research and training, it permeates the entire process of interdisciplinary talent cultivation, focusing on “project-based research on complex issues” to strengthen students' interdisciplinary practical abilities. Diversified training forms provide students with multi-scenario research experiences. Laboratory rotation systems allow students to move and learn in different disciplinary laboratories. For instance, the MIT interdisciplinary laboratory provides opportunities for students to receive guidance from professors in different disciplines. Industry internships build bridges between theory and practice. At Texas A&M University, the Data-Enabled Discovery and Design of Energy Materials program places students in internships at government or corporate laboratories, while interdisciplinary seminars promote ideological collision. Regular “Interdisciplinary Forums” held by the Cambridge-MIT Institute, along with lectures given by experts from academic institutions, industry, and government laboratories organized by Princeton University’s Materials Science Joint PhD Program, have significantly broadened students’ academic horizons (Liu & Cui, 2024). At the same time, research training emphasizes problem-oriented design, ensuring that both course projects and dissertations address complex interdisciplinary issues (Jiao, 2017). For instance, the University of Washington's interdisciplinary PhD program requires students to integrate theories and methods from at least two distinct disciplines in their dissertation research, thereby achieving interdisciplinary knowledge application through a “problem-driven” approach.

3.4 Support System: Institutional Innovation in Faculty, Resources, and Evaluation

The diverse and integrated faculty team, precise resource guarantee, and scientific quality monitoring together constitute the support system for interdisciplinary talent cultivation in American research universities, providing institutional guarantees for the sustainable development of interdisciplinary education.

In terms of faculty construction, the development of interdisciplinary faculty teams is centered on “diversity” and “integration”. It emphasizes the innovation of interdisciplinary integration and actively recruits teachers from different disciplinary backgrounds but with disciplinary relevance to join the interdisciplinary project team. It effectively enhances the quality of interdisciplinary courses and provides students with diversified interdisciplinary dissertation guidance and academic research support. Research universities in the United States mainly adopt two models (Sá, 2008): “joint appointment system” and “dedicated appointment system”. The joint appointment system, also known as the virtual cluster model, was first established by the University of Wisconsin-Madison in 1998. Teachers are selected to join the “virtual cluster” formed around specific interdisciplinary topics and are affiliated with the original department and the interdisciplinary programs. Faculty members in the PhD program in Applied Physics at the University of Michigan not only undertake teaching tasks in their original departments, but also participate in the development of interdisciplinary courses and

student guidance. The “dedicated appointment system” involves interdisciplinary institutions using independent personnel authority to appoint dedicated faculty, ensuring full commitment to interdisciplinary work. The faculty team at the Bredesen Center at the University of Tennessee belongs to this category (Jiao, 2017). Additionally, supporting systems further guarantee the enthusiasm of teachers. The University of Michigan has formulated specific rules for the assessment and promotion of interdisciplinary teachers, incorporating interdisciplinary curriculum development and joint research results into the evaluation system to avoid the lack of belonging caused by ""dual identity” (Cheng et al., 2022).

Resource support is precision-oriented, and funding support has formed a multi-source investment mechanism of “government + university + society.” The NSF NRT Program and the NIH T32 Program provide national-level special funding.. Universities like Stanford and MIT have established interdisciplinary scholarships to directly fund students' participation in research projects, while the IGERT project funds are primarily used for graduate stipends, tuition fees and academic activities, ensuring more resources are used for talent cultivation. Infrastructure construction focuses on the integration of physical space. For instance, Stanford University's Clark Center adopts an open layout design. This design not only facilitates communication through its open architectural layout, but also allows postdoctoral researchers and graduate students to move freely in the open laboratories to receive guidance from different professors, thereby promoting interdisciplinary convergence and exchange (Xu & Tao, 2018).

Quality monitoring adopts a system of “multi-stage assessment + multi-disciplinary evaluation”. The multi-stage assessment includes qualification exams, comprehensive exams, and thesis defenses. The qualification exam serves as a threshold exam to screen students with potential for interdisciplinary learning. The comprehensive exam, which combines written and oral tests, assesses students’ ability to integrate knowledge and design research.. For instance, the “General Examination” at the University of Washington focuses on evaluating the breadth and depth of students' knowledge. The thesis defense, on the other hand, examines the innovation and interdisciplinary value of students' research outcomes.. The multi-disciplinary evaluation mechanism is mainly reflected in the interdisciplinary supervisor team system. Members of the thesis advisory committee must come from at least two disciplines to ensure the interdisciplinary nature of the research. Meanwhile, interdisciplinary programs regularly conduct “peer reviews”, inviting experts from different disciplines outside the university to evaluate the training plans and course quality, so as to further guarantee the interdisciplinary orientation of the research (Jiao, 2017).

4. Implications for Interdisciplinary Talent Cultivation in China

Research universities in China have actively explored interdisciplinary talent cultivation. For instance, Tsinghua University has established the Institute for Interdisciplinary Information Sciences, focusing on the integration of information science with multiple disciplines. Zhejiang University has launched

the “Artificial Intelligence (AI) + X” program to promote the deep integration of AI technology with various disciplines. However, the current development still faces severe challenges. In terms of organizational structure, traditional departmental divisions have formed obvious barriers, hindering the flow of resources and collaborative innovation between different disciplines. In terms of the evaluation system, the rigid discipline-oriented model struggles to adapt to the needs of interdisciplinary research, inhibiting the enthusiasm of teachers and students for interdisciplinary exploration. In terms of resource allocation, insufficient investment has led to the dispersion of resources across various disciplines, making it difficult to provide adequate support for interdisciplinary projects. Drawing on the mature experience of American research universities and fully considering the current situation of education development in China, we can systematically promote the reform of interdisciplinary talent cultivation from three key dimensions: governance system, curriculum reform, and support mechanisms.

4.1 Constructing a Governance System and Organizational Model of “University-level Coordination + Institute-level Collaboration”

In the construction of the governance system, it is necessary to strengthen top-level design and organizational innovation, and establish an operational mechanism of “university-level coordination + institute-level collaboration.” At the university level, they can set up the “Interdisciplinary Education Leadership Group”, led by the university president or a vice president. The group will take overall responsibility for the planning of interdisciplinary programs, resource allocation, and departmental collaboration. Meanwhile, interdisciplinary talent cultivation should be incorporated into the evaluation indicators of the “Double First-Class” construction, giving priority to interdisciplinary programs in terms of enrollment scale and funding investment. Through such policy guidance, promote the development of interdisciplinary education. In terms of organizational form, piloting the establishment of the interdisciplinary department can be considered. Drawing on the practical experience of Tsinghua University’s Institute for Interdisciplinary Information Sciences, such departments should be granted academic decision-making power and personnel authority equal to those of traditional departments. Meanwhile, promote the “Graduate School Coordination + Department Collaboration” model, establish an “Interdisciplinary Program Office” responsible for program application, course coordination, and quality monitoring, thereby breaking down the administrative barriers between departments. In addition, collaboration between different universities is a crucial pathway to expanding interdisciplinary boundaries. High-level universities can be encouraged to jointly establish interdisciplinary degree programs, realizing the sharing of faculty, courses, and laboratory resources, thus forming a regional collaborative partnership in talent cultivation.

4.2 Promoting Curriculum Reform Guided by Interdisciplinary Orientation

Curriculum reform needs to take an “interdisciplinary orientation” as its core and break down the departmental barriers of traditional disciplinary education. During the undergraduate period, universities can refer to the HUM program at Princeton University and the general model at Stanford University. Design integrated general education courses around different themes to strengthen students'

interdisciplinary knowledge foundation. Nanjing University has established a three-level "1+X+Y" core curriculum system for AI general education. Its teaching and learning are based on one compulsory core course in AI general education, X AI literacy courses, and Y advanced courses that deeply integrate AI with various disciplines, aiming to explore practical approaches for the in-depth integration of AI and education. At the postgraduate level, universities can promote the "interdisciplinary course package" system. For instance, the "AI + X" program requires postgraduate students majoring in computer science to complete three compulsory courses in the corresponding discipline, thereby achieving a balance between "professional depth and disciplinary breadth". In addition, efforts should be made to break down barriers between different schools, disciplines and majors to the fullest extent feasible, strengthen the sharing and integration of course resources, enhance the construction of general education and professional foundation courses, and provide students with more conditions for their major studies (Liu & Liu, 2024). The sharing of high-quality interdisciplinary resources can be achieved by establishing a cross-university sharing platform, such as the "National Online Open Excellent Courses".

4.3 Innovate a Diversified and Collaborative Interdisciplinary Resource Support Mechanism

A well-developed support mechanism is key to the sustainable development of interdisciplinary talent cultivation. Innovation can be achieved in three areas: faculty management, funding channels, and evaluation systems. In terms of faculty management, universities can adopt a faculty allocation model that combines the "dual-appointment system" and "mobile positions", and clarify the rights and interests of interdisciplinary teachers in assessments and promotions. For instance, Fudan University provides a 20% workload subsidy for teachers who teach across departments, and establishes an "Interdisciplinary Faculty Development Fund" to support teachers' participation in interdisciplinary training and academic exchanges, thereby enhancing their interdisciplinary literacy. In terms of funding channels, it is necessary to establish a diversified investment system, set up a national special fund for interdisciplinary talent cultivation, and adopt a "rolling funding + mid-term evaluation" mechanism based on the NSF NRT model. Meanwhile, drawing on the cooperation model between interdisciplinary laboratories and enterprises at Stanford University, universities can be encouraged to attract corporate and social donations, and form a funding guarantee pattern of "government leadership, university autonomy, and social participation. (Fan & Wang, 2017)" The reform of the evaluation system needs to break through the limitations of "discipline-centric" evaluation, establish an "Interdisciplinary Contribution Index", and incorporate jointly published papers, interdisciplinary curriculum development and achievements in industry collaboration into the evaluation system for teachers and students. At the same time, implement an interdisciplinary program evaluation mechanism that combines "peer review + social evaluation," inviting industry experts and corporate representatives to participate in quality reviews, ensuring the quality of interdisciplinary talent cultivation is aligned with social needs.

5. Conclusion

The practice of interdisciplinary talent cultivation in American research universities has shown that its core value is not “formal interdisciplinary” but through strategic planning, organizational innovation, model reform, and institutional guarantees to build a collaborative development ecosystem of “knowledge-ability-literacy” and achieve resonance among “talent cultivation, social needs and academic frontiers”. Research universities in China need to base themselves on their own realities, draw on international experience, break free from over-reliance on traditional education systems and explore approaches to interdisciplinary talent cultivation with Chinese characteristics. They should not only prioritize a “problem-oriented” approach but also focus on “institutional innovation.” Only in this way can they cultivate compound innovative talents capable of leading future industrial transformation and social development, and provide intellectual support for China's high-quality development.

References

Cheng, J. K., Li, Y. P., & Xue, L. (2022). How to Improve Interdisciplinary Postgraduate Education: Based on US Experience & Inspiration. *Journal of Graduate Education*, (04), 90-97. https://doi.org/10.19834/j.cnki.yjsjy2011.2022.04.14

Di Giulio, A., & Defila, R. (2017). Enabling university educators to equip students with inter- and transdisciplinary competencies. *International Journal of Sustainability in Higher Education*, *18*(5), 630-647. https://doi.org/10.1108/IJSHE-02-2016-0030

Fan, D. Q., & Wang, X. M. (2017). Upholding Excellence: Characteristics, Trend and Enlightenment of Interdisciplinary Talents Cultivation in American Research Universities. *Journal of National Academy of Education Administration*, (09), 80-86. https://doi.org/10.3969/j.issn.1672-4038.2017.09.013

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies.* Sage Publications.

Holley, K. (2009). The challenge of an interdisciplinary curriculum: A cultural analysis of a doctoral-degree program in neuroscience. *Higher Education*, *58*(2), 241-255. https://doi.org/10.1007/s10734-008-9193-6

Jiao, L. (2017). Study on the Agent, Pathway and Mode of Training Interdisciplinary Graduate Students in American Research Universities. *Studies in Foreign Education*, *44*(03), 16-26.

Jiao, L., & Zhao, Q. N. (2019). From Structure to Mantra for Change: Organizational Behavior Analysis on Interdisciplinary Transformation of American Research Universities. *Research in Higher Education of Engineering*, (04), 139-144+187.

Liu, F., & Liu, Z. L. (2024). The Practical Dimension and Enlightenment of American Undergraduate Curriculum Reform in the Popularization Stage. *Higher Education of Sciences*, (05), 108-116. https://doi.org/10.3969/j.issn.1000-4076.2024.05.016

Liu, X. N., & Cui, Y. C. (2024). Practical Paths and Implications of Interdisciplinary Cultivation of Graduate Students in America's Top Universities. *Journal of World Education*, 37(05), 63-72. https://doi.org/10.3969/j.issn.1672-3937.2024.05.08

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2005). *Facilitating interdisciplinary research*. The National Academies Press. Dhttps://doi.org/https://doi.org/10.17226/11153

Newell, P. (2007). Knowledge, power and the politics of interdisciplinarity. *Environmental Politics*, *16*(3), 391-409.

Nowotny, H., Scott, P., & Gibbons, M. (2001). *Re-thinking science: Knowledge and the public in an age of uncertainty*. Polity Press.

Peng, S. L., Xiao, G. F., & Zhang, S. S. (2022). The International Trend and Reform Revelation of Postgraduate Innovative Talents Training from The Interdisciplinary Perspective. *Scientific Management Research*, *40*(03), 136-142. https://doi.org/10.19445/j.cnki.15-1103/g3.2022.03.018

Princeton University. (n.d.). *Integrated science*. Retrieved September 3, 2025, from https://lsi.princeton.edu/integratedscience/

Sá, C. M. (2008). Interdisciplinary strategies in U.S. research universities. *Higher Education*, *55*(05), 537-552. https://doi.org/10.1007/s10734-007-9073-5

Stanford University. (n.d.). *Interdisciplinary programs*. Retrieved September 3, 2025, from https://www.stanford.edu/academics/programs

Sun, J., Song, Y. F., Qie, H. X., & Wang, S. B. (2024). On Establishment Mechanism of Interdisciplinary Organizations for Medical and Industrial Intersection between Universities—Example of Harvard-MIT Health Sciences and Technology. *Research in Higher Education of Engineering*, (04), 172-177.

Welch-Devine, M., Shaw, A., Coffield, J., & Heynen, N. (2018). Facilitating interdisciplinary graduate education: Barriers, solutions, and needed innovations. *Change: The Magazine of Higher Learning*, *50*(5), 53–59. https://doi.org/10.1080/00091383.2018.1510268

Xu, L., & Tao, T. (2018). Innovation of Training Models in Interdisciplinary Postgraduate Education: Focused on Competence and Identity. *Journal of Xiamen University (Arts & Social Sciences)*, (02), 65-74.

Zhang, X. B., & Liu, B. C. (2025). From Separation to Integration: Foreign Experience on Interdisciplinary Education and Its Localization. *Heilongjiang Higher Education Research*, *43*(02), 62-67. https://doi.org/10.19903/j.cnki.cn23-1074/g.2025.02.005

Zhu, Y. D., Zhang, Z. G., & Ye, Y. J. (2015). Characteristics and Enlightenment of MIT's CrossDisciplinary Postgraduate Training. *Research in Higher Education of Engineering*, (02), 134-138.