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The Current Situation and Experiential Insights of First-Class Discipline Construction in the United States and the United Kingdom

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Abstract

This paper mainly focuses on the current cases of first-class discipline construction in the United States and the United Kingdom, summarizes the typical characteristics and successful experiences of constructing first-class disciplines abroad, and puts forward relevant suggestions to promote the "Double First-Class" construction in our country and province, namely, strengthening disciplinary cultural construction; emphasizing the cultivation of innovation and entrepreneurial abilities; focusing on the development of characteristic disciplines; promoting interdisciplinary integration of disciplines; establishing a first-class faculty team; and enhancing investment in first-class discipline construction.

Keywords

World-class disciplines; current cases; characteristic experiences; "Double First-Class" construction.

1. Introduction

World-class discipline is a term with "Chinese characteristics." Building world-class universities and disciplines is a major strategic decision for national education, which is of great significance for enhancing the level of education development in our country, strengthening the core competitiveness of the country, and laying a solid foundation for long-term development. In view of this, the domestic academic community has paid great attention to the selection and construction of world-class disciplines. Scholars at home and abroad have conducted extensive discussions on a series of important issues related to world-class disciplines, such as the essence, concept, characteristics, standards, construction goals, and development paths of world-class disciplines. This paper mainly focuses on the current cases of first-class discipline construction in the United States and the United Kingdom, summarizes the typical characteristics and successful experiences of constructing first-class disciplines abroad, with the aim of providing reference and guidance for the current "Double First-Class" construction in our country and province.

2. Current Situation and Cases of First-Class Discipline Construction in the United States and the United Kingdom

2.1. Physics Department at Princeton University, USA

Princeton University in the United States is one of the eight Ivy League schools, and its physics department is ranked among the top in the world. The physics department at Princeton currently has 73 faculty members, including 6 Nobel Prize winners in physics, 12 MacArthur Fellows, 4 highly cited researchers in the Essential Science Indicators (ESI), and 11 members of the National Academy of Sciences. The distinctive features of physics education at Princeton lie

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in the establishment of multiple committees and interdisciplinary organizations (such as the Humanities Committee, Science and Technology Committee, International and Regional Studies Institute, etc.) to coordinate and enhance interdisciplinary education and research for undergraduate and graduate students. In addition, Princeton has established an International Programs Office to encourage students to study and conduct research at internationally renowned universities based on their interests and majors. As a result, the department has produced numerous outstanding talents in physics and other fields, such as Bardeen, the Nobel Prize winner in physics, Weiss, the discoverer of gravitational waves, and Witten, the Fields Medal winner. In terms of scientific research, according to the 2020 QS Global Subject Rankings, the department's average citation score for papers in physics is 94.1, ranking 2nd globally. In the 2020 GRAS Physics Subject Rankings, the department's number of top journal papers ranks 8th globally. In terms of laboratories and equipment, the physics department at Princeton has a number of internationally renowned experimental platforms, such as the Joseph Henry Laboratory, the Nanomicroscope Laboratory, and the Quantum Coherence Laboratory, providing a cutting-edge experimental environment for high-level physics research for both faculty and students.

2.2. Chemistry Department at Massachusetts Institute of Technology (MIT), USA

The chemistry department at MIT in the United States has always been at the forefront globally, with its mainstream discipline rankings consistently in the top three in recent years. The chemistry department at MIT currently has 35 faculty members, including 1 Nobel laureate in chemistry, 7 highly cited researchers in the ESI, 10 members of the National Academy of Sciences, and 15 fellows of the American Academy of Arts and Sciences. The talent cultivation characteristics of the department include a focus on experimental courses, with experimental course credits accounting for 61% of the total required credits for degrees; an emphasis on interdisciplinary education, with graduate students typically required to rotate between different laboratories or studios; and an emphasis on internationalization in education, allowing students to apply for exchange programs at the chemistry research departments of internationally renowned universities for one year. Consequently, the department has produced numerous outstanding talents in chemistry and other fields, such as Woodward, the master of modern organic synthesis, Lippard, the pioneer of bioinorganic chemistry, and Swanson, the founder of Genentech. In terms of scientific research, according to the 2020 QS Global Subject Rankings, the department's average citation score for chemistry papers is 96.5, ranking 8th globally. In addition to emphasizing high-quality paper publications, the department also places special emphasis on original research findings. For example, Clark Sheehan successfully synthesized penicillin, and Cotton pioneered the field of atomic cluster chemistry. In terms of laboratories and equipment, the department has the National Research Center for Laser Biomedical Research, with 7 nuclear magnetic resonance spectrometers, X-ray diffraction equipment, Beckman XL-I analytical ultracentrifuge, and other world-class biophysical instruments.

2.3. Mathematics Department at the University of Oxford, UK

The mathematics department at the University of Oxford in the UK enjoys high global recognition and is at the forefront of international subject rankings. The mathematics department at Oxford currently has over 170 faculty members, including 3 Fields Medal winners, 2 Abel Prize winners, and 1 Rolf Nevanlinna Prize winner. Oxford offers around 250 undergraduate courses and over 300 graduate courses, forming a distinctive composite course model at Oxford. The department has produced numerous outstanding talents in mathematics and other fields, such as physicist Hawking, Fields Medalist Donaldson, and renowned writer Carroll. Oxford is the largest research center in the UK, with academic papers published in top

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international journals exceeding any other university in the UK. In the 2020 REF assessment results, the research output of the mathematics department at the University of Oxford includes 492 items, with 45.2% at the world-leading level and 58.5% at the internationally excellent level. Oxford also has rich and advanced teaching and research resources, with world-class libraries, museums, and other service facilities. Additionally, Oxford provides rich electronic databases, such as Datastream, Scopus, Physical Engineering, and Computational Information Systems, for faculty and students to access the latest literature.

2.4. Biology Department at the University of Cambridge, UK

The biology department at the University of Cambridge in the UK has consistently been at the forefront globally and has a strong academic reputation. The biology department at the University of Cambridge currently has over 600 faculty members, including 26 Nobel laureates in physiology or medicine and 24 Nobel laureates in chemistry. Cambridge emphasizes the cultivation of students' innovation and problem-solving abilities, providing students with opportunities for innovation and entrepreneurship in practice, guiding students to transform knowledge, research results, and patents into tangible productivity, and achieving a perfect combination of academia, industry, and research. Cambridge also provides a good scientific research and innovation platform for teachers, with its biology department collaborating with various biotechnology companies such as GlaxoSmithKline, AstraZeneca, Genentech, Roche, and Pfizer in different research areas. The department has produced numerous outstanding talents in biology and other fields, such as Darwin，the founder of evolution theory, Edwards, Nobel laureate in physiology or medicine, Qian Yongjian, Nobel laureate in chemistry, etc. The research funding for the biology department in 2021-2022 reached 200 million USD, mainly from UK charities, the International Bank for Reconstruction and Development, the Royal Society, etc. In the 2020 REF subject assessment, 37.4% of the research output of the Cambridge biology department was at the world-leading level, and 49.2% was at the internationally excellent level. Cambridge has interdisciplinary research institutions such as the Proteomics Research Center, Psychoanalysis Laboratory, and Stem Cell Research Institute, as well as 7 biology-related professional libraries. These laboratories and libraries provide faculty and students with a free, ample experimental space, rich experimental materials, and advanced experimental equipment for high-level scientific research.

3. Characteristics and Experiences of First-Class Discipline Construction in the United States and the United Kingdom

3.1. Typical Characteristics of First-Class Discipline Construction in the United States and the United Kingdom

3.1.1. Emphasis on Innovation and Interdisciplinary Studies

World-class disciplines often have cutting-edge, interdisciplinary, and leading research directions that keep pace with the times. The research areas of the case disciplines include not only basic theoretical knowledge but also applied research in multiple fields and new research areas resulting from interdisciplinary studies. Multi-disciplinary applied research is the application of the discipline in other fields, such as mathematical research in medicine and finance. This is an important measure for integrating academia, industry, and research. Interdisciplinary studies form the basis for creating new fields, such as biochemistry research, mathematical computing research, and physical chemistry research. The case disciplines include many interdisciplinary research centers and applied research teams that support research in various fields. It is also the basis for the case disciplines to produce innovative results, cultivate innovative talents, and create social values.

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3.1.2. Building a High-Level Faculty Team

The level of a first-class discipline largely depends on the level of its faculty team. World-class disciplines inevitably have outstanding faculty members and numerous academic masters with international influence and reputation. The faculty team is an important factor in the development of the discipline, and the faculty team of the case disciplines includes not only well-known leaders such as Nobel Prize winners and members of the National Academy of Sciences but also young and middle-aged academic backbone members, forming an academic ladder of "senior, middle-aged, and young—transmitting, aiding and leading" to drive the continuous and long-term development of the discipline.

3.1.3. Cultivating Socially Recognized Talents

Talent cultivation is the fundamental mission of a university. World-class disciplines often produce elites and leaders in various fields. The innovative and entrepreneurial abilities of their graduates are recognized by various sectors of society. The graduates of the case disciplines have made significant scientific breakthroughs not only in their respective fields but also in other areas, for example, as prominent politicians, entrepreneurs, and writers, etc.

3.1.4. Cultivating High-Level Research Results

World-class disciplines must cultivate and produce many high-level, original, and groundbreaking research results. These discoveries often drive the development of the discipline and bring significant economic or social benefits to the country. At the same time, innovative research results are inseparable from international research platforms, advantageous characteristic discipline groups, and good research resources.

3.1.5. Having a Good Academic Reputation

First-class disciplines inevitably have a good academic reputation, not only among peer experts but also among various sectors of society. Academic reputation generally includes academic reputation, teaching reputation, and employment reputation, mainly evaluating the discipline comprehensively and systematically in terms of teaching, management, teacher ethics, graduate employment, social contributions, and cultural atmosphere. The excellent teacher team, sufficient resource support, personalized teaching services, and high employment rate of the case disciplines are necessary conditions for having a good reputation. A good academic reputation also attracts the best students, ensuring high-quality student sources.

3.1.6. Having Deep Cultural Accumulation

World-class disciplines are not built overnight; they are gradually accumulated over a long period of development. They have a long history and deep cultural heritage. At the same time, they have accumulated excellent academic conditions during the development of the discipline, forming a free and relaxed academic atmosphere. From the case disciplines, it can be seen that they have created a tolerant, free academic atmosphere that allows teachers to freely combine teaching and research, cultivate students' spirit of pursuing truth and perseverance in research.

3.2. Successful Experiences of First-Class Discipline Construction in the United States and the United Kingdom

3.2.1. Adhering to the Coordinated Development of Teaching, Research, and Social Services in Terms of Discipline Functions

All world-class disciplines adhere to the close integration of teaching, research, and social services. The case disciplines advocate for all teachers to participate in frontline teaching, strengthen the relevance of teaching content to local society and industry, encourage students to participate in teacher research projects, cultivate students' teamwork, research innovation, and social service capabilities, provide opportunities for teachers and students to participate in enterprise practices, and guide the integration of scientific research, technological innovation,

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and social services. In summary, teaching, research, and social services mutually promote and coordinate development, serving national strategic needs together.

3.2.2. Emphasizing the Coexistence of Fundamentals and Frontiers in Terms of Discipline Settings

From the perspective of discipline settings, all world-class disciplines have a coexistence of basic and frontier disciplines. Basic disciplines provide a theoretical foundation for the development of frontier disciplines. Frontier disciplines lead the discipline field and represent the height of discipline development. The physics department at Princeton University has expanded from basic physics and theoretical physics to frontier research fields such as high-energy physics, condensed matter physics, mathematical physics, biophysics, nuclear physics, and astrophysics. Discipline construction can only expand research fields and align with international frontiers on a solid and profound foundation of basic research.

3.2.3. Focusing on Developing Characteristic Areas in Terms of Discipline Development Strategies

The resources of a university are limited. In the strategic planning of discipline development, world-class disciplines adhere to the guiding principle of highlighting key points and developing characteristic disciplines. Starting from their own reality, the case disciplines identify advantageous discipline directions, create discipline clusters, and in long-term educational practices, build distinctive, outstanding, and unique world-class disciplines. For example, the California Institute of Technology timely shifted its research focus to geochemistry and geophysics during its development process, fully utilizing the resources of the chemistry and physics departments to create a discipline cluster in geochemistry, geophysics, and planetary science, ultimately developing into a top earth science discipline in the United States.

3.2.4. Focusing on Introducing Top Talents from around the World in Terms of Faculty Team Construction

In building the faculty team, world-class universities place great emphasis on attracting high-level talents. The faculty members of the case disciplines generally have international research backgrounds and strong research innovation capabilities. In the process of talent introduction, the case disciplines not only focus on improving salaries, building laboratories, and other hard conditions to attract talents but also pay attention to soft conditions such as humanistic environment to attract talents.

3.2.5. Emphasizing the Cross-Integration of Multiple Disciplines in Terms of Discipline Structure

World-class disciplines are not isolated; their development requires the support of basic disciplines, resources from adjacent disciplines, and conditions that support the development of the discipline. The case disciplines place great emphasis on interdisciplinary studies, establishing interdisciplinary research centers, institutes, or laboratories to promote interdisciplinary integration and collaboration, and actively using resources that support the development of the discipline.

3.2.6. Insisting on Attracting External Resources and Improving Internal Enterprise Benefits in Terms of Discipline Resources

The development of world-class disciplines requires advanced equipment, the most authoritative and comprehensive data resources for support, and these resources are built on a foundation of sufficient and sustained funding. The case disciplines have sufficient funding guarantees. Given the differences in national conditions and school characteristics, their sources of funding also vary. Funding for public universities in the United States mainly comes from the federal government and local governments, while private universities rely mainly on revenue from school enterprises, social donations, the use of patents, and research fundraising.

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Funding for British universities mostly comes from government subsidies from the Higher Education Funding Council for England and the National Education and Leadership Institute, with some coming from self-raised funds.

4. Insights and Suggestions for the "Double First-Class" Construction in Our Country and Province

4.1. Strengthening Disciplinary Cultural Construction

The current division of disciplines in our country has a strong artificial planning feature, which reduces the intrinsic relevance of the knowledge system. This forced division of disciplines undoubtedly creates artificial divisions and barriers between disciplinary cultures, which in turn become obstacles to the development of disciplinary cultures. Therefore, it is necessary to weaken disciplinary boundaries, establish an inclusive and collaborative academic community, explore commonalities in disciplinary cultures, and promote mutual understanding and recognition between disciplines. Openness in disciplinary culture is an important part of building first-class disciplines in our country, as well as a part of the internationalization of first-class disciplines in our country. First-class discipline construction in our country should break through closed and rigid cultural patterns, while strengthening exchanges and cooperation between Chinese universities and world-class disciplines.

4.2. Emphasizing the Cultivation of Innovation and Entrepreneurial Abilities

First, we should strengthen the construction of innovation and entrepreneurship courses. Based on the close connection between the discipline and industry needs, form an integrated curriculum system from the perspectives of curriculum philosophy, curriculum objectives, curriculum content, curriculum structure, and curriculum activities. In terms of curriculum content, while including basic knowledge of innovation and entrepreneurship, it should also include the refinement of professional levels of innovation and entrepreneurship. In terms of teaching methods, theoretical knowledge should be linked to practice, not only through knowledge impartation in the classroom but also through practical courses to effectively improve students' relevant skills. Additionally, universities should pay attention to campus culture construction with innovation and entrepreneurship as the main theme, creating a free and open academic atmosphere.

4.3. Focusing on the Development of Characteristic Disciplines

The construction of characteristic disciplines should meet the needs of national strategic development and adapt to local economic development. To achieve sustainable development, characteristic disciplines must actively focus on the needs of national and social development and contribute to national and local economic and social development. Building characteristic disciplines requires innovative ideas to guide, high-level faculty teams and academic masters to drive development, and high-level bases and original research results to support. Different characteristic disciplines are formed under different subject backgrounds. Therefore, characteristic disciplines should choose suitable paths according to their own situations to develop disciplines in appropriate ways and at appropriate speeds. In summary, universities should actively seek the integration points between different disciplines, tradition and modernity, discipline development and national strategy.

4.4. Promoting Interdisciplinary Integration

Interdisciplinary studies are a new driving force for university development and a necessary condition for building world-class disciplines. However, the discipline organization structure of Chinese universities, mainly based on "one school, one college, one department," is not conducive to interdisciplinary cooperation, interdisciplinary education, and the cultivation of

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high-quality interdisciplinary talents. Therefore, firstly, interdisciplinary institutions should be established, such as interdisciplinary research institutes, academic innovation organizations, comprehensive laboratories, etc., to promote cooperation between schools and departments horizontally. Secondly, attention should be paid to building discipline clusters, linking closely related different disciplines to form a multi-disciplinary group advantage. Thirdly, interdisciplinary buildings should be constructed to unite scientists from different disciplines and different laboratories, providing convenient space and environment for interdisciplinary integration and synthesis.

4.5. Establishing a First-Class Faculty Team

Firstly, reform the current teacher appointment system, break the limitations that excellent teachers find it difficult to be recruited and redundant teachers find it difficult to leave, activate the employment mechanism, and promote talent mobility. Secondly, advocate for the "master + team" organizational model, build a good academic ladder for disciplines. In the faculty team, there should be renowned leaders, academic backbones, and energetic young members. Through teamwork, the team members gradually develop independent research capabilities and team leadership, promoting the sustainable development of the faculty team. Thirdly, create a free and relaxed research environment, cultivate innovative teams across disciplines and fields.

4.6. Strengthening Investment in First-Class Discipline Construction

All the aforementioned measures are inseparable from financial support. It can be said that without sufficient funding, discipline development is difficult. Building world-class disciplines is a long-term development process. Therefore, it requires continuous financial support from the national, local, and social forces as a guarantee. At the same time, universities should increase the promotion of donation culture, encourage donations from various sectors of society to universities; actively collaborate with enterprises in research, establish businesses, obtain loans, and raise funds through multiple channels to expand sources of income.

5. Conclusion

Based on the analysis of top disciplines in the United States and the United Kingdom, we believe that the common characteristics of world-class disciplines include a strong academic reputation and rich cultural heritage, a focus on building high-level faculty teams and cultivating high-quality talents, and a high regard for interdisciplinary collaboration and research innovation. The successful experiences in constructing top disciplines in the United States and the United Kingdom indicate that, in terms of disciplinary functions, it is essential to uphold the coordinated development of teaching, research, and social service; in terms of disciplinary structure, attention should be paid to the coexistence of foundational and cutting-edge aspects; in terms of disciplinary development strategies, efforts should be concentrated on developing distinctive disciplinary areas; in terms of faculty team construction, emphasis should be placed on attracting top talents globally; in terms of disciplinary structure, the emphasis should be on the integration of multiple disciplines; and in terms of disciplinary resources, it is crucial to attract external resources and enhance the efficiency of internal enterprises. The construction of world-class disciplines in China should adhere to the core principles of Chinese characteristics and world-class standards, rooted in the Chinese soil, aimed at enhancing international competitiveness and serving the economic and social development. It should inherit and develop the outstanding traditional Chinese culture in a progressive manner, and strive to explore a path of constructing world-class disciplines with Chinese characteristics and regional features.

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