

# Analysis on the Development of Dominant Discipline Clusters in Universities: Based on Synergetic\*

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**Abstract** The formation of dominant discipline clusters in universities is categorized into 4 development stages of professional subject, discipline, discipline cluster, and dominant discipline cluster. With the theory of synergetic, this paper analyzes the system elements, fast variables, order parameter in each phase, explains the factors contributing to changes between different stages and describes their evolution process in university functions. Finally, corresponding countermeasures are proposed to promote the formation of dominant discipline clusters in universities from the angles of internal system and external environment.

**Key words** Dominant discipline cluster; Synergetic; Fast variable; Order parameter

## 1 Introduction

To build a cluster of advantageous disciplines are popularly regarded as an effective way for universities to gain competitiveness, for which the current researches, however, are still limited within the scopes of practices. The research on this topic is still far beyond theoretical generalization or integration between theory and practice. For examples, Ju Jianfeng (2007) argues the importance of focus on careful planning and innovation of operation mechanism for a proper organization of cluster disciplines<sup>[1]</sup>. Huang Meifang (2008) emphasizes the contribution of specified objectives and orientation for innovative regional development for the success of advantageous clusters of advantageous clusters<sup>[2]</sup>. Han Yueping (2005) proposes several alternatives for the development of advantageous discipline clusters such as merging and combination, joint operation and flexible alliance, and countermeasures of improved organization and management, differentiated guidance and better policy mechanism<sup>[3]</sup>.

Based on Dissipative Structure Theory and under conditions of open systems far from equilibrium, Synergetic lays emphasis on the fact that in the complex large system, collaborative behaviors of subsystems produce joint functions that exceeds individual's separate roles, bringing about a unified and combined system. This is instructive in the analysis on the formation of dominant discipline clusters in universities.

## 2 Formation Stages of Dominant Discipline Cluster in Universities

From the development of higher education, dominant discipline clusters in universities have undergone the following three stages, from professional stage to academic stage, from discipline to discipline cluster phase, from discipline cluster to dominant discipline cluster stage. These phases have their own purposes with clarity, that is, the change from the professional to the academic stage is the change from meeting the demand of the society to the development of knowledge, the process from discipline to discipline cluster phase is the change from knowledge development to knowledge innovation, and the development from discipline cluster to dominant discipline cluster is the strengthening of educational functions of universities and highlighting of school thinking and educational features.

### 2.1 Development from the professional subject to the academic stage

From the university point of view, professional subject is to assume the function of personnel training. From a social point of view, subjects are set up to meet the social demand for professional personnel, who need relevant training. Therefore, from the point of view of supply and demand for talent training, professional subject is a combination of supply and demand. "Discipline" is defined as the logic of knowledge, and the division and identification of a relatively stable specific scientific research. Therefore, discipline is a professional basis, providing support for professional personnel training with unique properties in scientific research.

During the development of higher education, from home and abroad, to cultivate talent is the initial stage. Berlin University, founded by Humboldt, emphasizes on the realization of research functions, the

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shift from the single function of personnel training to the double functions of personnel training and scientific research, a leap from professional to academic development.

### **2.2 Development from discipline to discipline cluster**

The leap from professional to academic development can be manifested in the cultivation of post-graduates besides the change to dual functions mentioned above. Establishment of Berlin University is a turning point in world development of higher education. Laboratories were established, creating a new model of graduate education in modern sense, which is the beginning of graduate education and has influenced the world ever since<sup>[4]</sup>.

After the founding of new China, graduate education of China has experienced ups and downs. The process from discipline to discipline clusters is closely related to the building of departments. In the 90s of the 20th century, as China's economy continues to develop, higher education has also developed rapidly. The setting of campus education takes the form of university, school and department management mode, which means the transition from disciplines to discipline clusters. The landmark with significance in this period is the sixth degree authorization meeting conducted by the State Council Academic Degree Committee. In May, 1995, five first-class disciplines were authorized to be experimental units, symbolizing the concern on the development of discipline clusters from the government<sup>[5]</sup>.

### **2.3 Development from discipline cluster to dominant discipline cluster**

The change from discipline to discipline cluster and then to dominant discipline cluster seems to be a coincidence but from the national level, the two stages are closely linked.

When Academic Degrees Committee of the State Council in 1995 introduced experimental units for disciplinary authorization, it also launched a national key project - "211 Project". This has a profound and important impetus to higher education in China and a huge impact in the world, signifying the transfer to construction of key and important discipline clusters with characteristics. In 2007, the State Council Academic Degree selected 286 subjects to be national key disciplines, 677 second-class national key disciplines and 217 important disciplines (cultivation) in the third-round assessment work, marking the leap to the construction of dominant discipline clusters. This stage of development conforms to the inevitable trend of history and is the change from scale and quantity development to content and characteristic construction<sup>[6]</sup>.

## **3 Synergetic Analyses on the Various Stages of the Formation of Dominant Discipline Clusters**

In accordance with the theory of synergetic the formation of dominant discipline clusters in universities can be analyzed systematically.

### **3.1 Professional subject stage**

When in the professional stage, the system consists of teachers, teaching conditions and undergraduate training. Responsibilities of teachers are relatively simple, which is to carry out teaching activities, training undergraduate talents for the society. So in the professional stage, the function is unified, that is, to train the required personnel for the community. During this period of development, there would be fast variables.

### **3.2 Discipline stage**

As for order parameter volume in professional phase, when teachers in the same profession desire to seek further development in a competitive environment, their teaching work will only be part of the work and turn some of their energies to scientific research. When professional research funding and research projects undertaken increase with rapid speed, the order parameter in the professional phase will no longer be the order parameter, but the fast variables, which marks the birth of another stage – discipline stage.

When in subject phase, the system elements have changed. As research funding and the number of research projects increase rapidly, the competence and conditions to train postgraduates have been fostered. The essential factors, apart from the teaching staff in the professional stage, undergraduate training and teaching conditions, are postgraduate training, scientific research and research conditions, and thus discipline phase differs dramatically from professional stage, because of the two major functions of research and postgraduate training.

### **3.3 Discipline-cluster stage**

The continuous development of a discipline is bound to bring about the development of other related disciplines, which broadens the vision scope of the discipline. The combination of theoretical

research and applied studies will enhance the rapid development in academic levels and competence.

When in the discipline cluster stage, the system elements have changed. Because of the significant improvement in research abilities, the competence to train doctoral students is enhanced. Besides the elements of teaching staff, undergraduate education, teaching conditions, post-graduate training, scientific research and research conditions in discipline stage, knowledge innovation is added in this phase, and thus its function has changed for the better.

**3.4 Stage of dominant discipline cluster**

The continuous development of a discipline cluster will gradually become the focus and characteristics of universities. It is also closely related to the prestige and influence of the universities in the society. So it will be the focus of universities and key construction inputs, and gain attention and support from local governments. After a certain period of development, the overall strength improves significantly. Specifically: rapid scale development of doctoral education, breakthroughs continually made in national scientific research awards, significant increase of high-level teachers (including the Changing Scholars, winners of Outstanding Youth Fund). Order parameters change into fast variables, meaning the step into the stage of dominant discipline cluster.

In dominant discipline group stage, the system elements have changed. In this period, the discipline cluster becomes increasingly influential, making an embodiment of the influence and competitiveness of the university in the society. Elements of the system during this period are the teaching staff, undergraduate education, teaching conditions, post-graduate training, scientific research, scientific terms and knowledge innovation, and the influence of the university is also added. Different phases of the system elements, fast variables and order parameters are in table 1.

**Table 1 Elements of the System, Fast Variables and Order Parameters in Different Stages of the Formation of Dominant Discipline Cluster**

Stage	System elements	Fast variables	Slow variables (Order parameter)
Professional Subject stage	Teachers, teaching conditions, undergraduate education	The scale of teaching staff and undergraduate education	Research funding, the number of research projects undertaken
Discipline stage	Teachers, scientific research, undergraduate education, postgraduate training and research conditions	The scale of teaching staff and undergraduate education, research funding, the number of research projects	Scale of graduate students, number of high-level research projects, awards and basis
Discipline cluster stage	Teachers, scientific research, undergraduate education, postgraduate training, scientific research conditions, knowledge innovation	The scale of teachers, undergraduate and graduate education, research funding, the number of research projects undertaken, the number of high-level research projects, provincial and ministerial level awards, provincial-level scientific research basis	Doctoral education scale, state-level scientific research prizes, high-level teachers (including Changing Scholars, winners of Outstanding Youth Fund)
Dominant discipline cluster stage	Teachers, scientific research, undergraduate education, postgraduate training, knowledge innovation, the influence of university	The scale of teachers, undergraduate and graduate education, research funding, research projects, the number of high-level research projects, provincial and ministerial level scientific research prizes and basis, doctoral education scale, state-level scientific research awards, high level teachers	Major national scientific research projects (including the “973”, “863” National Social Science Foundation and other major research topics of major subjects), academicians

Based on the synergetic analysis on all the stages in the formation of the dominant discipline clusters in universities, the development from professional stage to stage of the dominant discipline clusters is obvious: in the professional stage, the educational goal is mainly to cultivate undergraduates for the society, only one main function; in the discipline stage, and the pursuit of knowledge development is another goal, the functions being widened, expanded from undergraduate education to scientific research and personnel training (including training undergraduate and postgraduate students);

in discipline cluster stage, the aim is the pursuit of knowledge innovation, its functions being improved, which includes personnel training, scientific research and knowledge innovation; in the final stage of dominant discipline cluster, the pursuit of their goal is to highlight the school characteristics to expand the university social influence and competitiveness, reflecting an upgrading of the ideas of education.

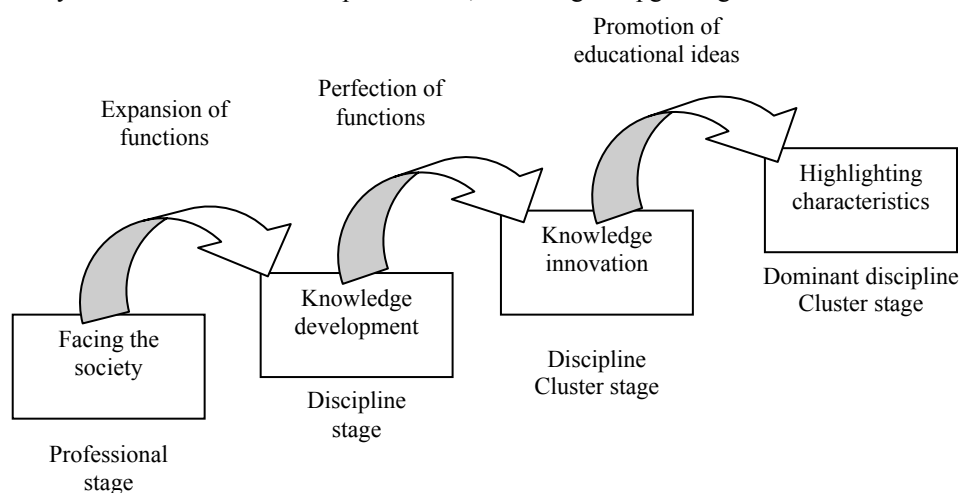


Figure 1 Development of Dominant Discipline Clusters in Universities

#### 4 Synergy of External Environment and Internal Elements of Dominant Discipline Clusters in Universities

Synergy of dominant discipline clusters in universities is that of external environment and internal elements.

##### 4.1 Discipline cluster collaboration with external organizations

The discipline cluster is seen as a system, and outside the organization is its environment, including the central education authorities, other relevant ministries, local governments and relevant management authorities, relevant management agencies within universities and related industries. In accordance with Synergetic, to get a better development, it is essential for the discipline clusters to establish good collaborative relationship with these organizations.

In addition, the discipline clusters should pay attention to the links with related industries, and strengthen cooperation with the major enterprise. Discipline construction is meant for researches, personnel training and social services, and its goal is to contribute to the development of society, and in the process, to seek community support, which is a basic and fundamental point of university development.

##### 4.2 Synergies between internal disciplines within discipline cluster

When achieving the university disciplinary collaboration with external organizations, dominant discipline clusters should also strengthen the academic collaboration within internal disciplines, forming the force of "1 + 1 > 2" and ensuring the promotion of overall strength of dominant discipline clusters.

The current organizational structure of dominant discipline clusters, generally speaking, includes colleges and a number of related research institutes and units, which are independent secondary units. Therefore, synergy of dominant discipline clusters is first the collaboration in management of individual colleges and research institutions, including the management system and operation mechanism. As the colleges and the research units are independent organizations, but belong to the same discipline cluster, so in scientific research, faculty development, personnel training, base building, synergy is essential between colleges and research institutions to achieve "1 + 1 > 2" effect. Therefore, the university management system should strengthen management of secondary institutions within the same discipline cluster.

Secondly, there is a need to achieve synergy in scientific research, faculty development, personnel training, and base construction. The internal elements of discipline cluster construction include research field, scientific research, faculty development, personnel training and base building and these involve the collaboration between colleges, scientific research units to achieve the promotion of the orderly and effective development of discipline clusters.

In academic research field of dominant discipline clusters, it is important to grasp the international forefront of academic development, closely integrate major national development needs, and adjust the direction of academic research. At present the society is in rapid development, where knowledge is constantly updated, and the information exploded. Knowledge update is very quick, so that university discipline clusters should closely follow the development of frontier areas, exerting advantages and influence in the academic frontier, which is the key for development of dominant discipline clusters.

Finally, subjects and courses which belong to the discipline cluster need collaboration, mutual support, mutual promotion and common development. Theoretical disciplines focus on the basic theories, while applied disciplines focus on practical application, so these two disciplines is under mutual influence, mutual restraint, and the synergy between these two is essential for the development of discipline cluster. Without a good theory basis, it is difficult to have breakthroughs and innovations in applied researches. This is the fundamental reason why innovation is inadequate in scientific researches and why the state increases its basic research efforts. Therefore, the construction of dominant discipline clusters in universities not only involves the building of basic theory disciplines but that of applied disciplines, for the formation of adaptation and development mechanism, balance and imbalance mechanism, coexistence and competition mechanism.

## 5 Conclusions

Adaptation and development mechanism means that in ecological system of disciplines, various disciplines should actively seek their harmonious coexistence with the surrounding environment and actively seek their own adaptation to the environment, coordination and interaction with the environment, forming their own healthy development mechanism. Balance and imbalance mechanism is to strengthen stability and anti-jamming capability of ecosystem of disciplines during the construction of dominant discipline clusters, optimizing the discipline structure, and strengthening the construction of multi-level diversity. In higher learning institutions, a number of national or provincial or ministerial key disciplines or university-level important and general disciplines should be set up to create a reasonable multi-level system. Coexistence and competition mechanism means that in the ecological system of disciplines, all disciplines influence and interact with each other, when a certain subject develops; it will enhance the overall academic reputation and school influences, which is beneficial to other disciplines. In addition, the development of a subject brings about the interaction and communication between disciplines, while having the impact on other disciplines. Therefore, there is need to strengthen the construction of dominant discipline clusters, by strengthening the process, promoting the improvement of overall strength of university disciplines. As the ecological system of disciplines exist within the same university, and share common resources (i.e., university personnel, finance, materials, etc.), in the development process, there is inevitably competition. Universities' limited resources make the competition between disciplines more severe, thus forming a competitive relationship.

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