Research on the Competition and Synergy Mechanism of Higher Education System Based on Its Complexity Characteristics

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Abstract. Based on the dissipative structure characteristics of self-organization system of higher education, this paper analyzes the driving forces are from two attributes: competition and synergy which influence self-organization evolution of higher education system from the superstructure, the middle structure and substructure. The findings suggest that: the tension between two attributes jointly influence the development and evolution of higher education system. Synergistic competition (benign competition) is conducive to the development of higher education system, and promote the sustainable development of higher education. On the contrary, excessive competition or weak competition will lead the system itself to a state of disorder and hinder its development.

Introduction

According to the characteristics of complex giant system, higher education is a complex giant system, with the system open, the number of the subsystems "huge", the system types various and the characteristics of the system structure multi layered. Higher education as an open and complex giant system, its internal subsystems constitute the formation of interaction, mutual tolerance of an organic whole with self-adaptability and self-organization. High education systems tend to be more diverse and complex with the rise of various student groups, and the increase of students enrollment, teaching faculty and even disciplines.[1] In such a context, the higher education system develops into a complex giant system, which consists of a large number of subsystems. The species, quantity and level of the subsystem are diverse and heterogeneous. The internal subsystems of higher education are interdependent and interrelated. With the complexity and non-linearization of the external environment, the internal elements of the higher education system and the external environment constitute a complex system with self-organizing characteristics. In the evolution of the system, it exchanges material, energy and information with the outside world constantly. At the same time, the institutional environment, policy environment, market environment, cultural environment and other uncertain factors may have different impacts on the system.

The environment of modern higher education system is experiencing more rapid changes than ever before, and the subsystems are evolving in time and space, which constitute the dissipative structure of higher education system. The social system is developing rapidly with the scientific and technological changes are making great progress. The driving force of the evolution of the higher education system is mainly the interaction of competition and synergy. It is very important to explore the competition and synergetic mechanism in the higher education system and analyze the evolution and the essence of the development of higher education system, to rationally carry out the top design of higher education and promote the sustainable development of higher education.

The Dissipative Structure as Self-organization System of Higher Education

Self-organization system refers to organize on their own, be self-creation, self-evolution without specific instruction from outside. It can run autonomously from disorder to order, to form a structured system. [2] Self-organization is a system to reduce its own entropy content through the exchange of material, energy and information. Driven by the internal mechanism, the system continuously...
improve its own order from simple to complex, from rough to exquisite, to be adaptive and self-developed.[3] Higher education system is a dynamic complex giant system as a typical dissipative structure with openness, non-equilibrium, non-linearity and fluctuations.

**Openness**

"A closed system that does not have any exchange with the environment and can not produce self-organizing behavior. Open to the environment that is to exchange material, energy, information with the outside world to produce self-organizing movement."[4] Higher education system is a typical open system. The subsystems are interrelated and interact with each other, independent and dependent simultaneously. The openness of the higher education system is manifested in the exchange of material, energy and information with elements such as society, culture, politics, economy, technology and service. The higher education system provides science, technology, intelligence and talent support for the operation of social system. There is also a flow of resources between universities, disciplines and professions within sub-systems of higher education.

**Non-equilibrium**

Higher education system focuses on advanced knowledge, science, technology, innovative talents and other elements. The non-balance of the higher education system appears as differences in the interaction of external culture, politics, market and other factors. In the higher education system, the non-equilibrium performs as the allocation of resources, regional coordination cause the fairness and efficiency issues; administrative power has the impact on the academic freedom and social intervention; philosophy impels the development of general education and professional education; institutions and policies gives the direction of mobility of talents; structure and function changes profession reformation and so on. The non-equilibrium of the higher education embodies the complexity, uncertainty and dynamics of the system.

**Non-linearity**

The non-linearity of higher education is not only manifested in the non-linearity of its relationship with the external environment system, but also in the internal components and various subsystems. [5] The development of higher education system is affected by the political, economic, cultural, institutional and other factors, the speed of the development, success or failure, is the result of comprehensive internal and external environment. Just as the relationships between economy and education, equity and efficiency, quantity and quality are not purely linear. Non-linearity is inherent and fundamental of the higher education system. In the higher education system, the relationships between universities and disciplines, disciplines and professions do not necessarily cause another changes in the same way.

**Fluctuations**

The development process of the higher education system is a dynamic fluctuation process. The independent motion of the subsystems within the system, as well as their possible localized coupling, coupled with random fluctuations in environmental conditions, often deviate from its mean value and appear on the ups and downs. The ups and downs from the average is called "fluctuation". [6] The ups and downs of the parent system and the subsystems of the higher education system make their function and structure constantly adjust, and promote the evolution of the higher education system. When the system is in a steady state, the fluctuation range is small and can be ignored. But with the increase in the amplitude of the fluctuations, the spontaneous co-movement of the subsystem will impact the mother system. It will make the whole system deviate from a stable state. Has been the response of most subsystems fluctuations, from the local spread to the system, to promote the system into a new orderly state of the giant fluctuations. The function of the higher education system is composed of unitary to multiple, and the structure is from simple to complex. The model is from elite to popular and so on. All of these reflect the ups and downs of the independent movement of the subsystems in the system under the influence of environmental conditions. The fluctuations are necessary conditions for the orderly system of higher education.
The Driving Force of the Evolution of Higher Education System - Competition and Synergy

The development of higher education system is very similar to the situation of biological population evolution, facing the problem of survival and elimination. In the process of development of higher education system, competition and synergy are a kind of interaction with contradictory characteristics. In the process of system development, synergy is reached by competition, which leads to a new level of competition, forming a spiral development model. Many of the competition in the higher education system, involving competition between institutions, policies, organizations, theoretical schools, is often the most scientific or most consistent with the requirements of social development survived. Forming new systems, policies, organizations, theoretical schools that are widely accepted and recognized. With the change of time and space, form a new round of survival of the fittest. The development of higher education system is the cycle of competition - coordination - competition and the continuous completion of the process of self-organization. Moderate competition (synergistic competition) is conducive to the orderly development of higher education system, such as the construction of world-class universities and first-class disciplines, enhance the international influence, cultivate innovative talents and other initiatives. Over competition is not conducive to the overall development of the system, such as academic fraud and corruption, talent plan "hat project", resulting in a variety of problems, such as the decline of talents development quality, uneven distribution of resources and so on.

Darwin argues that competition is part of the struggle for survival. Begon argues that competition is a matter of limited resources, because of the common needs of individuals, thus affecting the individual's survival. Competition is common in the nature and human society. There are complex competitive activities between the higher education system, such as different states, the university systems of a country, the different faculties of a university, the different disciplines of a faculty, and the different professions of a discipline. Synergy refers to the complex large-scale system, in order to achieve the overall evolution goals of the system, the various subsystems or the various components of system in the way of mutual cooperation and support to form a benign circle. In this cycle, the cooperative behavior of each subsystem can produce "1 + 1 = 3" effect. In the higher education system, the synergies generated by the various subsystems through the cooperation to ease the competitive pressure, and because of the synergies of the competition and further increase the complexity of the system. The higher education system organization can be divided into three levels: the superstructure which is at the system level; the middle structure which is at the university level and the substructure which is at the level of discipline-based.

The Superstructure: the Competition and Synergy between Higher Education Systems

The medieval university of Europe is the most important achievement in the history of medieval education and becomes the root of modern university. The rise and development of the medieval university was closely related to the political system, the economic system and the cultural tradition at that time. The evolution and change of medieval universities is the result of competition and synergy. British historian analyzed the earliest struggle in the medieval Europe, where the central question they faced was why Bologna and its imitators in northern Italy survived, and in Salerno, the earlier and equally promising efforts have vanished. The main weakness of Salerno is that it does not develop a protective and cohesive organization to sustain its intellectual activity. Modern universities are characterized by nature, institutions, ideas, structures, functions, etc. The characteristic of the medieval university is the result of synergies. In the different higher education systems of different countries, the higher education system of developed countries has strong competitiveness and influence. Compete and cooperate with each other in the spiral of development.

Case 1: World-class University Construction Plan

The higher education system of each country is not isolated, and the authority of the higher education system embodies the competitive advantage of a country. In the fight for the authority of higher education, almost all the countries make world-class university as one important path. In 2016, China emphasis on building world-class university action. In many countries and regions, world-class university projects have been implemented. For example, the French "Sorbonne Union",
Russia's "5-100" project, Germany's "Outstanding Initiative" program, Japan's "Super Global University" program, South Korea "BK21 Project", Taiwan "Towards Top Universities" plan and so on. These projects aim at building world-class university in the country or region, promoting the international influence and competitiveness of the higher education system. In essence, this is the result of competition and synergy in higher education systems between different countries.

The Middle Structure: Competition and Synergy within the Higher Education System

Competition can lead to synergies, and synergies can lead to competition. The function of the higher education system from single to pluralistic is the result of competition and synergy. American modern universities are less affected by administrative planning, and are less supported and controlled by national systems. If universities do not consider the experience of others in the process of adapting to social changes, it may cause talent loss. In the decentralized higher education system, there is no fixed imitation of the structure, chaotic competition and drift behavior competition led to an orderly situation. Similarly, the development of China's universities have studied Japan, the United States, France, the former Soviet Union and other countries’ educational experience. China formed a higher education system through the transformation of traditional mode. That is, to reform and opening up as the driving force, to develop coordinate education as fundamental, to insist on scientific development as path and coordinated develop of the scale, quality, structure and efficiency.

Case 2: Coordinated Development of Strategic Alliance

Since the 1990s, strategic alliances and cooperation have become an important trend in organizational change. Strategic alliance is a management concept that is put forward for a highly competitive environment. It is a new modern organizational form called "the most important organizational innovation at the end of the 20th century." The higher education system is complex. In the context of knowledge economy and increasingly competitive environment, the higher education system changes from traditional competition to collaborative competition, setting a formation of strategic alliance of organizations to establish a common development of higher education ecosystem. In China's higher education system, the formation of university alliance directly under the Ministry of Education, provincial universities alliance and regional university alliance as the main forms. Besides that, World-class university alliance and other different levels of organizations constitute higher educational strategic alliance. The external environment of the higher education system is dynamic and uncertain. The alliance within the higher education system is generated by both the competition and interdependent synergies between the subsystems.

The Substructure: Competition and Synergy on the Same Elements of Higher Education System

Case 3: Discipline and Talent Competition

Mr. Pan Maoyuan pointed out: "From the overall structure of higher education, it includes both macrostructure and microstructure system, vertical and horizontal structure system, static and dynamic structure system". The complexity of the relationship between higher education structures can interpret through the specific structure of university disciplines. University is based on the disciplines of the system as the basic characteristics, each subject is often the resource contender of other subjects, but also resource provider for the other disciplines. China's higher education "985 project", "211 project", to some extent, highlight the "efficiency first, taking into account the fair" of higher education development. However, the previous focus on the construction of the program as a fixed identity and lack of competition features. That is, lack of dynamic competition mechanism in the discipline construction. In a larger higher education system, decentralized and competitive higher education systems are more conducive to scientific progress than centralized and non-competitive ones. This is mainly due to the fact that the former can provide opportunities for talented scholars, especially young scholars, to move from less attractive environment to the more attractive environment to display their talents. In the process of building world-class universities and first-class disciplines, the driving force behind innovation is a high level of talent."
program” is to promote the growth of young talent, but with a new round of competition for human resources, some departments of provinces and cities introduced a flood of "hat project", disrupting the normal academic ecology. The introduction of innovative talents caused excessive competition.

The Conclusion and Discussion

The competition and synergy in the higher education system are ubiquitous. In the disorder and order cycle, the overall development level of the higher education system is promoted, and the competition based on the synergy is the driving force. From the perspective of complexity system, the competition and synergetic relationship between the higher education system and its subsystems are constantly changing from disorder to order, from quantitative to qualitative change. Excessive competition or lack of competition easily lead to the decline in the quality of higher education, the unfair problem of resource allocation and so on. Through competitive and synergetic organic coupling (benign competition), it is beneficial to co-ordinate the interaction between the systems and subsystems. To maintain the balance and sustainable development of the system. The synergistic competition improves the competitiveness of the system and the subsystems, and also extends its collaborative network, which leads to the higher education system from low to high, from simple to complex, from disorder to order, from the edge to the core, from the subsidiary to the leading role.

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