

# Data Mining Learning Algorithm Application in Industrial Cluster and Collaborative Innovation in Higher Education

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## **Abstract**

*With the rapid development of the Internet big data, data mining technology has gradually become an important research content in the field of information technology. In this paper, the author research on the data mining learning algorithm application in industrial cluster and collaborative innovation in higher education. Industrial cluster can promote the cluster of higher education, and then change the layout of the regional structure of higher education. At the same time, the author constructs the performance evaluation of collaborative innovation in higher education, and analyzes the optimal path of collaborative innovation in higher education.*

**Keywords:** Data mining, Learning algorithm, Industrial cluster, Higher education

## **1. Introduction**

From the last century since 90s, database and network technology has been rapid development and wide application, the data collection and the ability to continuously improve, tens of thousands of database used to manage, office and scientific research [1]. However, in such a called the era of information explosion, while a massive data index increase, the other side is the low utilization of information, a large amount of data is a waste of resources, data mining knowledge discovery came into being [2]. The concept of industrial cluster was first proposed by American scholar Potter Michael, he believes that industrial cluster is an organic whole composed of a related industry, has close ties between the enterprises and other relevant institutions, industry group geopolitics, technology, value chain, industry association relationship formed in the specific field based on". Industrial cluster is a common phenomenon in the process of industrialization, and it is considered as a symbol of high quality and strong competitiveness [3-4]. Our government attaches great importance to the planning and development of industrial clusters [5]. The national development and Reform Commission clearly to make the development of industrial clusters and change the mode of economic development promote structural adjustment and industrial upgrading, promote technological progress, to achieve energy-saving emission reduction combine to strengthen the scientific planning guidance, optimize the industrial cluster environment [6]. At present, the industrial cluster has become an important part of China's overall industrial distribution and regional competitiveness. Research on the interaction between higher education and industrial clusters, through the strategic adjustment of the structure of higher education, to increase the support of regional economic and industrial cluster development, has important practical significance.

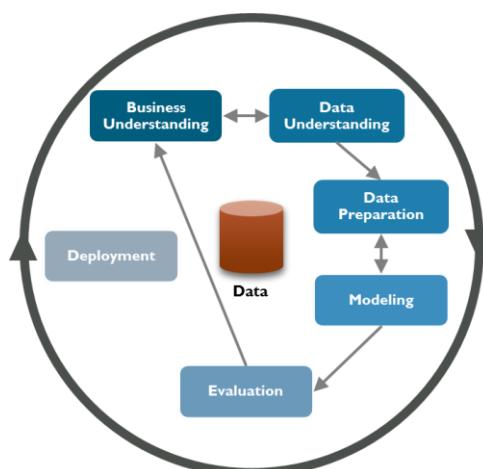
According to the domestic and foreign research on industrial clusters, mature industrial clusters generally have the following characteristics: first, the "group" characteristics, that is, the relative industrial enterprises in a specific geographical area of relative aggregation. The two is the "chain" structure, with one or several enterprises as a leader, gathered a group of clear division of labor, in the business with the relationship between

the upstream and downstream suppliers, manufacturers and distributors, formed a complete industrial chain and strong supporting capacity [7-8]. The three is the "network" form, that in addition to the main business, mature industry cluster also includes government, universities and research institutes, finance, science and technology intermediary service can provide policy, research and technology, capital and information support of the relevant agencies or organizations, the formation of interwoven network relationship between cluster enterprises and subject the formation, and can meet the demand for public services of various public service platform and a series of cluster sharing rules and procedures and systems. Four is to rely on innovation. Innovation is the fundamental driving force for the development of industrial clusters. Cluster enterprises rely on improving the ability of absorbing knowledge, improving the technological innovation environment, and realizing the core competitive advantage of enterprises. The research shows that it is precisely because of industrial cluster to achieve a variety of production factors in a certain region of a large number of agglomeration and effective concentration, and promote the overall optimization of productivity in the space layout.

## 2. Data Mining Learning Algorithm

### 2.1. Data mining

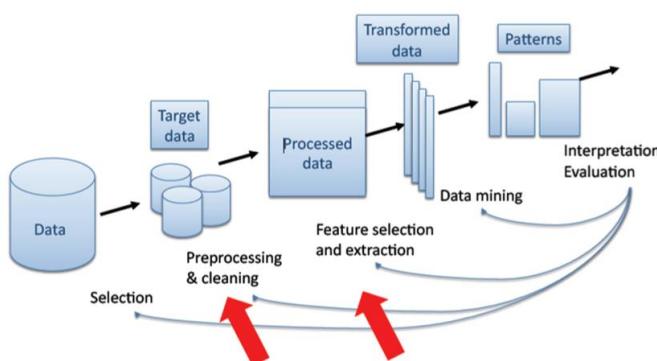
In recent years, with the popularity of computer technology, Internet has become the world's largest information network, which contains a huge amount of data, but because of the low utilization of information cannot be calculated. How to discover useful information from massive data and transform it into knowledge has become one of the main bottlenecks in the application of computer technology in this century. The data mining technology to solve this problem is to produce and develop rapidly, it is currently one of the research directions in database, data warehouse and information technology the most cutting-edge, has aroused widespread concern in various fields at home and abroad. How to find the valuable event, hidden in the huge database, for these events to be analyzed, in order to obtain meaningful information, and summarizes the useful knowledge for decision-making is based on the main problems to deal with data mining technology. The application of data mining technology is very wide, as long as there is an analysis of the value of the database and the need to use data mining technology to explore the purpose of the analysis.



**Figure 1. Data mining**

Although data mining has many advantages, but it also faces many problems, it also provides a broader space for the future development of data mining. Because of

the data, the task of data mining and data mining methods with diversity, which gives the data mining has put forward many challenges and the development of the subject, how to write a data mining language, how to establish the interaction and integration of the data mining environment, how to develop efficient and useful data mining method and system, and how to use the data the application of mining technology to solve large problems, are the main problems of current data mining research personnel, but also become the development trend of data mining technology. Data mining is a complete multi stage process, generally including business object, data preparation, data mining, and analysis of the results of the assimilation of knowledge of several major stages, knowledge discovery (KDD) process is a repeated process of the several stages.



**Figure 2. knowledge discovery (KDD) process**

Data mining technology can be used to analyze the current information and help the decision, although currently used in the field of education in higher education, data mining technology is not a lot, but how to apply data mining techniques in the field of teaching in higher education, and to improve the teaching quality and teaching efficiency is a topic worthy of study.

- 1) Analysis of students' characteristics: Based on the student's knowledge structure, learning style, analysis of information, historical performance and interest in learning, develop students' characteristics, according to the characteristics of the students to help students correct learning behavior, improve learning efficiency.
- 2) To predict the behavior of teachers and students: The teachers and students in teaching the basic information of the master database, using association rules and association analysis for relationship between teachers and students of each behavior, and according to the prediction of the behavior of teachers and students, and for the foreseeable behavior intervention, so we look forward to the direction of development in accordance with the.
- 3) Curriculum setting: Since there is a certain order and relevance between the courses, the students must complete the necessary pre course before they learn the following courses. If the order is reversed, it will affect the learning effect. In addition, due to their foundation and hobbies, educational background, teaching style and other aspects of the level difference, therefore, can be used in the data mining association rules and decision tree and other related functions, obtained valuable teaching rules and related information, to help the reasonable setting of curriculum.

- 4) Evaluation of learning effect: To evaluate the teachers' teaching and students' learning, to promote both the teachers and students of teaching and learning behavior, to stimulate the enthusiasm of students' learning and teachers' work, and to detect the effect on teaching and learning behavior. The relevant function through data mining, the process of teaching and learning effect analysis, discover on the teaching behavior to promote or hinder the information, and targeted for the development or improvement, to encourage advanced spur backward.

## 2.2. Learning algorithm

There are two basic problems in ontology relation learning: one is how to determine the existence of semantic relations between the concepts, namely the existence of the relationship; two is how to determine the semantic relationship types belong to the existing learning ontology relationship. The algorithm basically revolves around how to solve these two problems. In the corpus tagging named entity similarity and statistical probability using shallow syntactic tree to determine the semantic relation and relation types. To determine the relationship between the type of using conceptual clustering method is essentially a statistical method based on data mining provides a means of knowledge discovery, it is distinguished from the data set Effective, novel, potentially useful, and ultimately understandable patterns of non-trivial process”

$$w_{new} = w_{old} + \Delta w \quad (1)$$

Then, target output error can express as:

$$e_k(t) = \begin{cases} d_k(t) - y_k(t) & k \in T(t) \\ 0, & otherwise \end{cases} \quad (2)$$

The performance function of the network can be expressed as:

$$J(t) = \frac{1}{2} \sum_{k=1}^n [e_k(t)]^2 \quad (3)$$

The total performance function of the network is:

$$J(t_o, t_1) = \sum_{\tau=t_0+1}^{t_1} J(\tau) \quad (4)$$

Conclusion using the chain rule:

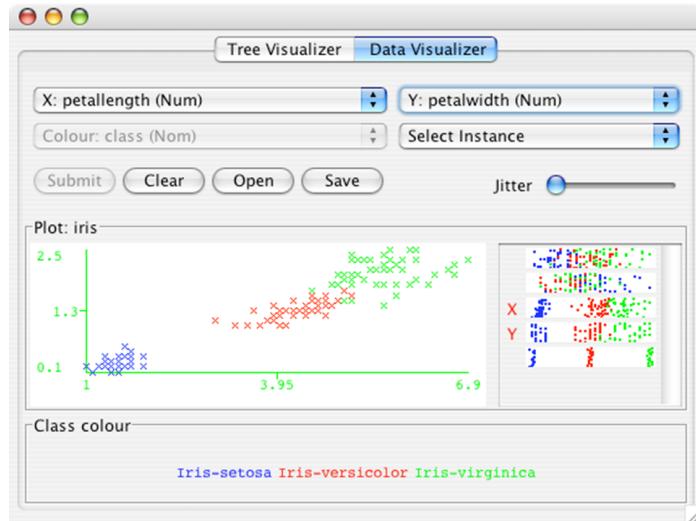
$$\frac{\partial J(t_0, t_1)}{\partial w_{ij}} = \sum_{k \in U} \frac{\partial J(t_0, t_1)}{\partial s_k(\tau)} \times \frac{\partial s_k(\tau)}{\partial w_{ij}} \quad (5)$$

Error as:

$$\delta_k(\tau) = \begin{cases} f'(s_k(\tau)) e_k(\tau), \tau = t_1 \\ f'(s_k(\tau)) \left( \sum_{j=1}^n w_{kj} \delta_j(\tau+1) + e_k(\tau) \right) \end{cases} \quad (6)$$

The gradient of the network performance function in the weight space is:

$$\nabla_w J(t_0, t_1) = \sum_{\tau=t_0+1}^{t_1} \delta_i(\tau) y_i(\tau-1) \quad (7)$$



**Figure 3. Learning algorithm**

### 3. Collaborative Innovation of Higher Education with Industrial Clusters

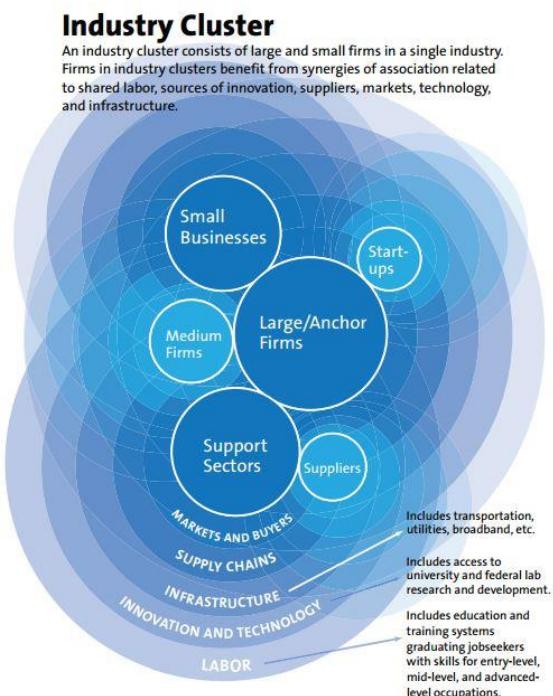
#### 3.1. The impact of industrial cluster on Higher Education

Industrial cluster, a new form of industry, has obvious "group" characteristics compared with the development of non-cluster enterprises in the past. This feature is not only reflected in the spatial position of enterprises on the relative concentration, more specialized division of labor relations of mutual cooperation, the competition among enterprises and depend on each other, and due to this kind of relationship sharing platform, common rules and common system, *etc.* These characteristics are different from the existence of the enterprise in the non-cluster state, which reflects the integrity and non-segmentation of each enterprise on the basis of relative independence. The demand of the industrial cluster to the higher education will break the need of the previous "point to point" service model, which reflects the characteristics of a "group" service. The impact of this characteristic on the structure of higher education is reflected in two aspects:

First, industrial cluster can promote the cluster of higher education to the geographical space of the cluster, and then change the layout of the regional structure of higher education. The industrial cluster of the production factors in a certain region and a large gathering of effective concentration, as a kind of strong external demand pull, will greatly promote the talents cultivated in higher education institutions and the power of science and technology in a variety of ways to cluster enterprises closer and agglomeration. Moreover, due to the "group" structure, to the agglomeration process of the industrial cluster in Colleges and universities, and to shorten the communication, reduce the communication cost between universities and enterprises, often through the establishment of a branch, the establishment of enterprise training base and build a science and Technology Research Institute,

industrial technology research Institute, industry research and development center base and other forms of industrial clusters in location, which leads to college cluster.

Second, the "group" characteristics of the industrial cluster make the service mode of higher education change, and then the depth of the professional structure of higher education. In the industrial cluster, the enterprise has not only appeared in the form of individual enterprises, but also highlights the appearance of clusters formed by many related enterprises and institutions. Therefore, the service of industrial clusters in the colleges and universities, will break through the "point to point" and "point to" service form, more prominent characteristics of the "group" service, showing a "multi point" and "many to many" service mode, organic coordination between different types of universities in different disciplines between and mutual integration. Such a state, will promote inter regional, inter school, inter professional and other large span of the university cluster, the emergence of the discipline of professional clusters, and thus the depth of the discipline of higher education professional layout.



**Figure 4. industrial cluster**

The so-called large span of the discipline cluster, is based on the nature and needs of industrial clusters, different universities, different disciplines (Group) among the aggregation, combination and integration. Its characteristics: one is the aggregation, refers to a variety of subjects or a number of disciplines of the collection and aggregation; two is the relevance, is the subject of aggregation in order to adapt and service industry cluster needs. What disciplines can be aggregated together to form a specific discipline cluster, mainly depends on the nature and needs of industrial clusters. Discipline cluster not only conforms to the modern discipline highly differentiated and highly integrated evolution path and mode, but also conform to the interdisciplinary needs to solve complex key technologies in the development process of industrial clusters, is a major change of higher education to adapt to the characteristics of industrial clusters. The so-called large span of professional cluster, is corresponding to the industry cluster industry chain position demand, different

colleges and universities, the organic polymer. Characteristics of the specialty cluster: first, the correspondence of the job positions with the industry chain; the two is the correlation between the professional and the similar. Which majors in Colleges and universities can be aggregated to a specific cluster, also depends on the nature and needs of the industrial cluster. Moreover, this kind of demand is directly related to the talent demand of cluster industry chain, and has the complementary nature of upstream and downstream. And have professional clusters that conform to the practitioners in the development process of industrial clusters similar to adjust and optimize the configuration of the same nature of professional courses, in the internal demand for liquidity in the similar occupation and education system.

### **3.2. Structure of Higher Education**

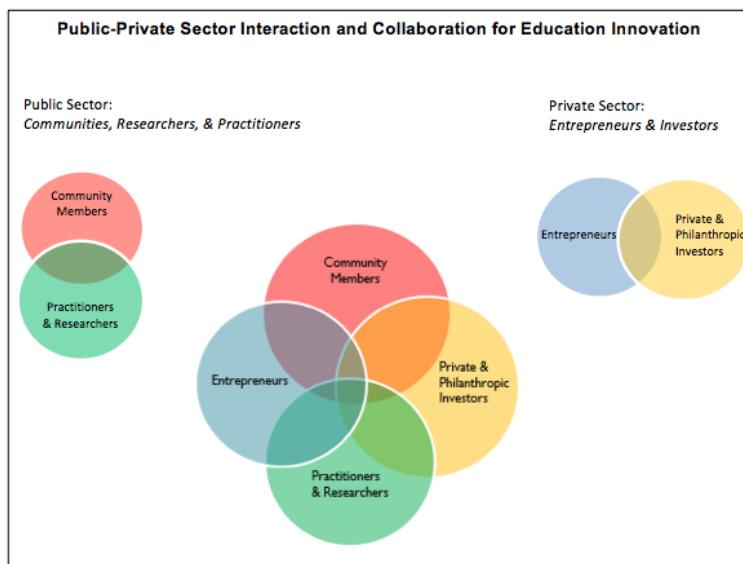
In addition to the obvious industrial cluster "group" phenomenon, but also reflects the "chain" structure characteristics, namely cluster enterprises through the professional division of labor, the various aspects of the organic industry chain together, so that the formation of the overall advantages of suppliers, manufacturers and downstream industry chain, to achieve the overall competitive advantage. The chain like structure requires the service of higher education to follow the development of the industry chain and promote the maturity of the industry chain. First, the chain structure of industrial clusters spawned a chain service of higher education, thus affects the layout of disciplines and research organization structure of higher education. Industry chain is undoubtedly the carrier of innovation chain; technological innovation must be attached to the industry chain. Discipline is the basic unit of knowledge, in theory, the key technology of each industry chain can through the discipline to organize research and achieve a breakthrough; each subject can provide service for the industrial chain, and realize the integration of innovation chain and industrial chain in every aspect. But in reality, the formation of the industrial chain often involves many disciplines.

Because of the industrial chain the key technology nodes have the intrinsic relation, the attachment in each node of the key project of science and technology cannot be independent of the objective needs to be established to promote the project, the relation between mutual cohesion and good combination structure. The higher schools and colleges, universities and research institutes, universities and enterprises, the cooperation between the cooperative mode and puts forward new requirement to get rid of demand between professionals, disciplines, scientific research, business, economic and social barriers, and vigorously promote the research of collaborative innovation; and collaborative innovation. In recent years, China's enterprises, universities, scientific research institutions or other organizations, to develop common interests and needs of enterprises of all parties as the basis, to enhance the ability of industrial technology innovation as the goal, in a legally binding contract for joint development, the formation of complementary advantages of security, sharing of benefits and risks of technological innovation cooperate organization of industry technology innovation strategic alliance, can be regarded as a new form of higher education reform the traditional organizational structure to a certain extent.

### **3.3. Path analysis of collaborative innovation in Higher Education**

The structure of higher education in our country is the result of the dynamic adjustment, and it is also the result of the government's administrative intervention, market regulation and self-regulation. Among them, the overall layout of the

formation of the planned economy era is the basic framework, after the reform and opening up to the reform of the management system for the rapid development of Higher Vocational Colleges and undergraduate colleges, large-scale new adjustment background of Popularization Background, local adjustment under the background of rapid development and regional economy, is an important cause of the formation of the current higher education regional structure. Industrial cluster is a new industrial form, which has been rapidly developed in our country. It has already formed a powerful external inducing factor, leading the resources of higher education to cluster in various ways. To a certain extent, this will break the existing higher education regional structure and form the regional structure of higher education resources, which is more in line with the needs of regional economic development and industrial distribution. To optimize the regional structure of higher education by industrial cluster, the main measures are to promote the regional higher education resources to the industrial cluster's tilt and flow. Due to the formation of specific industry clusters depends on the specific resources, but natural resources driving type, leading enterprises to form industry type, other types of traction investment type cluster, is still dependent on natural resource endowments, geographical advantages and other factors, the industrial cluster of these types of the science foundation area is not necessarily good.



**Figure 5. collaborative innovation in highereducation**

Higher education resources to the industrial cluster together, including the subject cluster, professional cluster formation of large span, and relying on the subject clusters, clusters and enterprises to build a professional institute of technology, industry research and Development Center (base) and all kinds of talents training base, but also including the regional structure of Higher Education for local adjustment. For example, under the leadership of the government to promote the overall relocation of some colleges and universities to the location of the industrial cluster, or in the industrial cluster of new colleges and universities, the establishment of a university campus, and so on. Various forms of higher education resources to the industrial cluster where the geographical space of the gathering, will inevitably change the traditional regional structure of higher education, the formation of a higher degree of association with the industrial cluster of new regional structure layout.

#### 4. Performance Evaluation of Collaborative Innovation in Higher Education

The evaluation indicators are as follows: (1) from the perspective of school, enterprise, society and politics, combined with collaborative innovation environment, input, process, and effect of the design of open questionnaire, and interviews with experts. (2) Using the results of the open questionnaire, combined with the results of literature research, a preliminary questionnaire (including one or two and three indicators) was formed, and a questionnaire was conducted. (3) Combined with the results of the pretest, the questionnaire was revised to form a formal questionnaire. (4) Use the principal component analysis method to determine the evaluation index of collaborative innovation in higher education, and the results are as shown in table 1. The importance of collaborative innovation in higher education has reached a common understanding. In order to effectively carry out collaborative innovation, higher education must begin to solve the following problems:

- (1) To create a good environment for innovation. The main innovation requires the introduction of a policy to promote collaborative innovation; higher education to promote the construction of Public Library and information network education resources, the gross enrollment rate, provide good social conditions for collaborative innovation; the formation of long-term mechanism including operation mechanism, management mechanism and incentive mechanism and so on; inside and outside the organization should set up a special the agencies and departments to be responsible for promoting collaborative innovation work; promote the organization management mode, strengthen the construction of organizational culture innovation and flexible.
- (2) Increase the input of the innovative subjects. To strengthen the innovation of the funds, personnel, venues, equipment and other aspects of investment, pay special attention to the effectiveness and sustainability of investment, strengthen investment resources management, improve the efficiency of resource use.
- (3) To strengthen the management of innovation process. Reasonable layout of system architecture collaborative innovation system, take reasonable communication channels and ways to improve communication efficiency; strengthen the innovation process optimization, improve the stability of the working process and balanced; avoid a hot phenomenon, improve the innovation of subject participation, the degree of integration, through mutual learning, knowledge sharing and communication, to achieve common growth.
- (4) Reasonable evaluation of innovation output. Considering the interests of the main innovation of the evaluation, collaborative innovation output from personnel training, discipline construction, scientific research, enterprise benefit, government output, multi subject, multi dimension and avoid the irrationality of single subject evaluation.
- (5) Focus on the dual impact of economic and social. Collaborative innovation should not only have to improve the transformation rate of scientific research achievement, promote the success rate of new product development and market share, improve the scientific and technological innovation of products in the market share of economic benefits; should also improve innovation awareness, promote the development of regional economy and promote the development of related industries, conserve resources and protect the environment and social benefits.

**Table 1. Higher education collaborative innovation evaluation index**

Evaluation index of collaborative innovation in Higher Education	First order index	weight	Second level index	weight
Evaluation index of collaborative innovation in Higher Education	Collaborative innovation environment	0.4255	Policy support	0.201
			Social conditions	0.064
			Institutional guarantee	0.105
			Organizational guarantee	0.142
Evaluation index of collaborative innovation in Higher Education	Collaborative innovation investment	0.3507	R&D expenditure	0.089
			technical personnel	0.056
			Research site	0.024
			R&D equipment	0.012
Evaluation index of collaborative innovation in Higher Education	Collaborative innovation process	0.2483	Communication efficiency	0.042
			working process	0.038
			Cooperative behavior	0.047
			Discipline construction	0.013
Evaluation index of collaborative innovation in Higher Education	Collaborative innovation effect	0.2012	Enterprise benefit	0.032
			Government output	0.011
			personnel training	0.015
			social influence	0.074

## 5. Conclusion

The background of the development of industrial clusters, promote the cultivation of talents demand docking with the industrial cluster of talents in Colleges and universities, on the one hand, the need to strengthen the professional level, the diversity of types of higher education, to improve the external demand of social adaptability; on the other hand, also need high school and give full autonomy, to improve their self-adjust the flexibility. To this end, one is to establish and perfect the market system of regional talent network, through the collection and release of each cluster needs information and all kinds of talent shortage, the market surplus and signal expansion of colleges and universities to access resources and information from social channels; two is to the school management to give more autonomy in professional college according to the situation of various colleges and universities, allowing the talent market demand signal and students independently set up and adjust the specialty, and to determine the size of the school and the corresponding charges; three is the government should evaluate the University similar professional organization of social forces to strengthen, and regularly to the public to promote the university rankings, and professional to achieve the survival of the fittest. In this way, the regional higher education personnel training type structure and the level structure will gradually tend to the macroscopic order and the

general equilibrium in the industrial cluster talent demand guidance and the government macroscopic management.

The industrial cluster as an inevitable result of relatively mature stage of industrial economic development is an important part of modern economic structure, different degree of influencing and changing the economic structure and regional structure of public service. This new form of industry, put forward new requirements for different support ability and service mode of higher education, we must combine the development trends and characteristics, build a new layout with its development needs of higher education structure.

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