Research on Independent Regulation Mechanism of Specialty Structure in Colleges and Universities Based on the Modeling Theory

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Abstract: The transformation development of newly built undergraduate colleges and universities is a profound reform of higher education in China. It is essential to explore the pathway to construct applied technological colleges and universities and improve the service capability of undergraduate colleges and universities for the economic and social development. And it is an effective method to optimize and regulate specialty structure of newly built undergraduate colleges and universities, avoid the repetitive setting of specialties and homogenization phenomenon, and improve school-running characteristics and the quality of applied talents cultivation. Systematical and scientific research shall be conducted on numerous relevant factors influencing specialty structure setting and regulation.

The transformation development of newly built undergraduate colleges and universities is a profound reform of higher education in China. It is essential to explore the pathway to construct applied technological colleges and universities and improve the service capability of undergraduate colleges and universities for the economic and social development. However, at present, the capability of newly built undergraduate colleges and universities to serve regional economic construction is weak, the homogenization phenomenon of specialty is serious, the gap between talents cultivated and the requirements of regional economic development is large, and the contradiction between supply and demand is prominent. Based on mathematical modeling, from the perspectives of industrial development, market environment, student enrollment and employment, financial costs and human resources, this paper constructs corresponding mathematical model with the quantitative and qualitative analysis to study specialty structure and setting so as to enhance the capability of colleges and universities to serve local economic society [1].

1. Relevant Concept Definition

1.1 Mathematical model

Based on the reference to literature, mathematical model is to sum up the relationship between internal factors and reveals the law of development of objective phenomena with mathematical methods according to phenomena observed from research subject.

1.2 Specialty structure

Specialty structure refers to proportional relation constituted by various specific specialties established in a college or university or in a certain region, reveals essentially the development status of regional economic society or industrial structure, and includes the extension and connotation, and the connotation of specialty structure is mainly studied in this paper.

1.3 Regulation mechanism

The regulation mechanism in this paper is that colleges and universities conduct mathematical modeling from specialty setting and construction status with the combination of qualitative and quantitative analysis, analyze scientific reasonability of specialty setting and structure, benefits of specialty quality with data analysis, adapt to social demands actively, and build advancing and retreating mechanism of specialty setting so as to strengthen the guidance and regulation of

specialty setting and construction and provide support for improving the construction level of specialty, promoting school-running characteristics and the strategic development of colleges and universities[2].

2. Analysis of factors influencing specialty structure regulation

Specialty structure regulation mainly refers to the regulation on specialty setting. There are many factors influencing specialty setting, which are related to costs of specialty construction, the quality of student enrollment, the quality of cultivation and industrial relevancy[3], shown specifically in Figure 1.

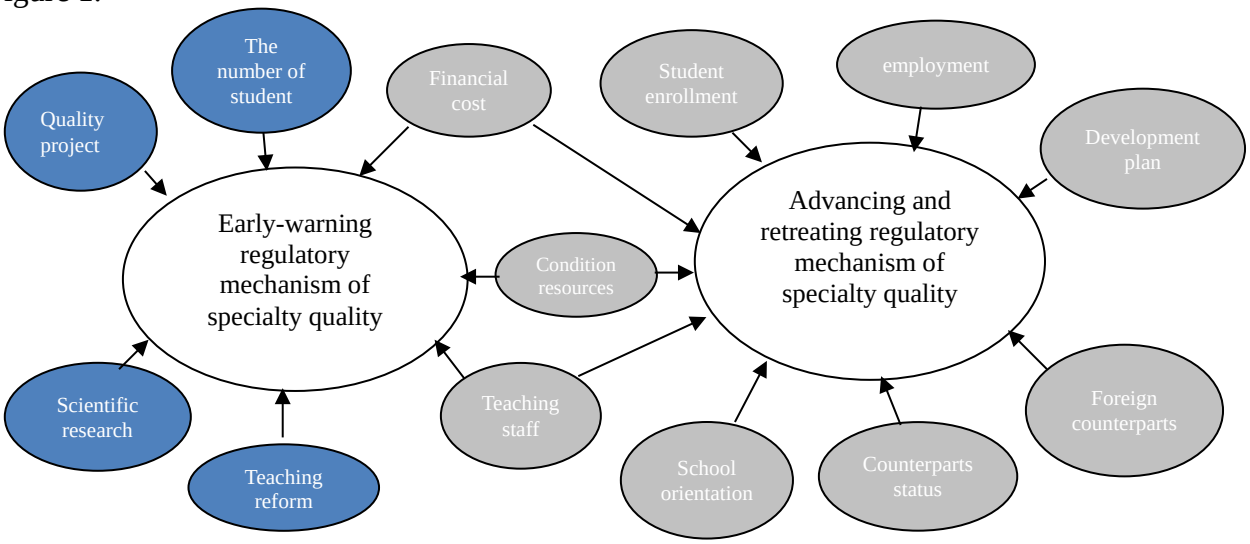

Figure 1 Analysis of factors influencing specialty structure regulation

To be more specific, factors influencing specialty setting mainly include internal and external factors.

2.1 Internal factors

Internal factors influencing specialty setting mainly involve the status of teaching staff, resource conditions, teaching level, scientific research level, the quality of students and financial costs[4].

2.1.1 Teaching staff

The core of specialty construction is the teaching staff, and the construction of teaching staff aims for the development of specialty, complementing and promoting each other. The core resources in colleges and universities is teaching staff, which is the fundamental, strategic and global task.

2.1.2 Resource conditions

Resource conditions is a basic condition for running a school, mainly involving the hardware condition and software condition of college and university. The hardware conditions mainly relate to such basic conditions for running school as school building and land, teaching equipment, books and document. The software conditions are mainly the culture, philosophy and etc. of colleges and universities. Resource conditions is an important condition affecting specialty setting.

2.1.3 Teaching level

Teaching level is one of the basic conditions for specialty setting. The quality of courses, the allocation of teaching materials, and high-quality teachers are the basic links for ensuring teaching standards. Diversification of teaching models also affect the teaching level.

2.1.4 Scientific research level

The ability of scientific research is an important factor affecting the specialty. The slow development of scientific research will make it difficult to improve professionalism, level, scale, quality and efficiency. The level of scientific research of teachers in a specialty directly affects the professional innovation ability of teachers and also affects the development of a specialty.

2.1.5 The quality of students

The quality of students is an important indicator that influences specialty setting. The admission rate of students' first choice, and award rate of students and other aspects affect specialty setting.

2.1.6 Financial costs

Each specialty setting requires a variety of costs, such as costs in teaching staff, laboratory costs, student enrollment costs, and employment costs.

2.2 External factors

The factors that affect specialty setting also include industrial development, peer status, enrollment market, and employment market.

2.2.1 Industrial development

The development of the industry directly restricts the future development direction of a specialty, and also affect the employment prospects of students. Specialty settings shall understand whether the industry of the specialty belongs to the Red ocean or Blue ocean.

2.2.2 Peer status

The peer status refers to the status of the same specialty in colleges and universities in the same level. The influence of peer status on specialty setting is mainly reflected in the fact that a large number of specialty peers indicates that the specialty is highly concerned, which affect the competitiveness of students in a certain college or university, less competitive in the future graduation market.

2.2.3 Student enrollment market

Extensive enrollment publicity and strong enrollment work have positive significance for the quantity and quality of students. The comprehensive index of enrollment data also reflects the scientific nature of specialty setting and the practicality of talent cultivation.

2.2.4 Employment market

The contradiction between quantity unemployment and structural unemployment has emerged in the employment market of college graduates in China. At the same time, there are significant differences in the employment of college students, and the factors such as college type, region, and specialty setting have different effects on the employment of college students in different majors. The changes in the job market will provide a certain basis for the specialty setting of colleges and universities, and will also affect the specific conditions of specialty setting [5][6].

It can be seen that there are many factors influencing specialty setting, and how to rationally regulate their respective specialty setting according to the actual conditions of each college and university has become an important aspect of concern for colleges and universities.

3. The Application of Mathematical Method in Regulation on Specialty Structure

3.1 Fishbone diagram of specialty regulation

In order to understand the influence of various factors on specialty structure regulation, this paper constructs the fishbone diagram of specialty structure regulation, shown in Figure 2.

The schematic diagram of the specialty regulation mechanism mainly proposes problem hypotheses, analyzes the internal environment and external environment of the specialty through data collection, and then carries out modeling verification. If the verification is correct, then it

enters the final stage of assistive solution and proposes aid decision-making; if the verification result is inconsistent with the actual specialty, it will return to the environmental analysis stage, analyze the specialty situation again and repeat the previous steps [7].

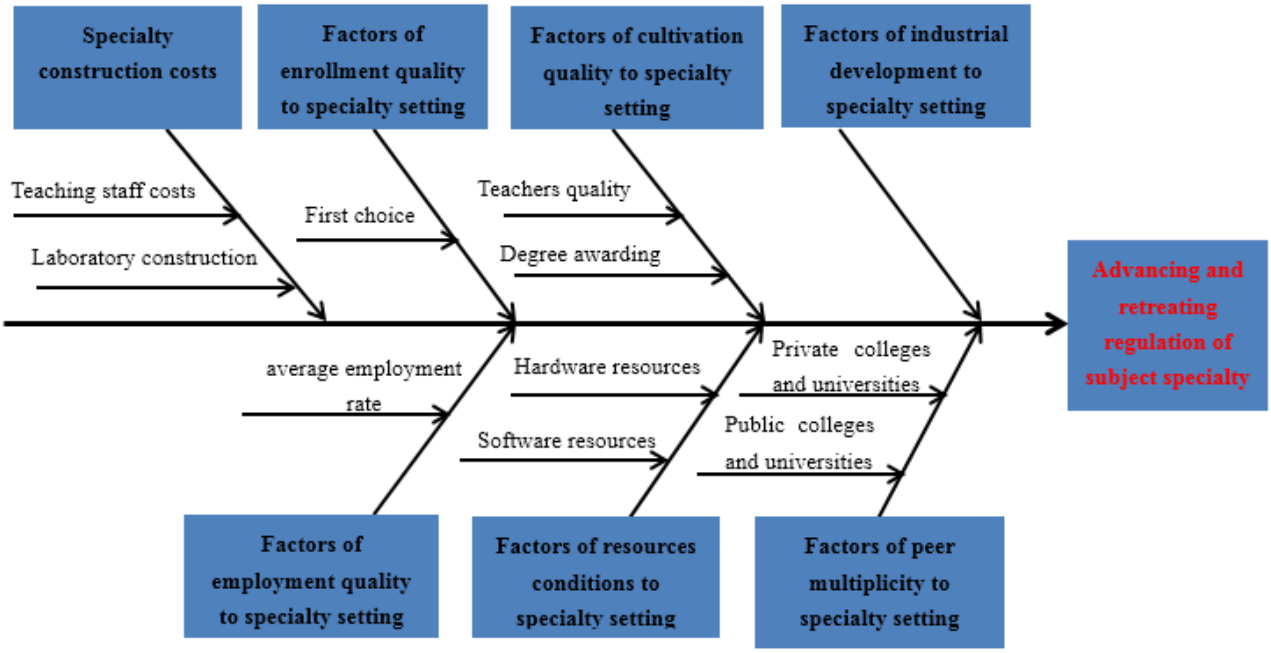

Figure 2 Fishbone diagram of specialty structure regulation

3.2 The construction of indicator system of specialty structure regulation

This paper builds indicator system of existing specialties and new specialties to better regulate specialties.

3.2.1 Evaluation indicator system of existing specialty structure regulation

Table 1 Indicator system of specialty structure regulation (existing specialties)

indicator system of specialty structure regulation（existing specialties）				
	First-class indicator	**weight**	**Second-class indicator**	**weight**
indicator system of specialty structure regulation	Industry conformity X	0.03		
	Specialty multiplicity M	0.04	Compared with public colleges and universities of the same type M_1	0.17
			Compared with private colleges and universities of the same type M_2	0.83
	Enrollment quality Z	0.10	The number of enrollment planned Z_1	0.06
			The number of first choice Z_2	0.11
			The number of admission Z_3	0.24
			The number of actual register Z_4	0.18
			Completion rate Z_5	0.22
			Popularity coefficient Z_6	0.18
	Employment rate J	0.13		
	Cultivation quality Q	0.44	The quality of students enrollment QS_1	0.39
			The rate of degree awarding of students QS_2	0.11
			The rate of teachers with high-grade professional titles QZ_1	0.12
			The rate of teachers with medium-grade and below professional titles QZ_2	0.04
			The rate of teachers with doctoral degree QX_1	0.19
			The rate of teachers with master degree QX_2	0.05
			The rate of students and teachers SB	0.10
	Costs C	0.26	The cost rate of teaching staff C_1	0.40

			The cost rate of enrollment C_2	0.23
			The cost rate of employment C_3	0.06
			The cost rate of laboratory construction C_4	0.31

This paper constructs indicator system of specialty structure regulation, including first-class and second-class indicators, and calculates the weights of each indicator, shown in Table 1.

3.2.2 Indicator system of new specialty structure regulation

This paper constructs indicator system of new specialties, shown in Table 2.

Table 2 Indicator system of new specialty structure regulation (new specialties)

Indicator system of new specialty structure regulation（new specialties）			
First-class indictor evaluation indicator	**weight**	**Second-class indicator**	**weight**
Industrial relevancy	0.071		
Specialty multiplicity	0.031	Compared with public colleges and universities of the same type	0.667
		Compared with private colleges and universities of the same type	0.333
Subject basis	0.048		
Teaching staff	0.434	The rate of teachers with high-grade professional titles	0.487
		The rate of teachers with medium-grade and below professional titles	0.061
		The rate of teachers with master degree	0.333
		The rate of teachers with master degree	0.118
Laboratory equipment	0.241	The cost rate of laboratory construction	0.833
		The cost rate of practice base	0.167
Seed-money	0.175	The cost rate of teaching staff	0.875
		The cost rate of specialty books and document	0.125

3.3 Weight setting

3.3.1 Relevant concepts

Weight refers to the relative importance of a certain indicator in the entire evaluation system. Weight calculation of indicator system in this paper mainly include hierarchy weight calculation and combination weight calculation.

3.3.2 Case of matrix evaluation

After the hierarchical chart, judgment matrix is built based on the affiliation of hierarchies. Specifically, there is dominance relation for a certain factor in higher hierarchy to a certain factor in the lower hierarchy, the relative importance of lower hierarchy is compared and granted with a certain value.

A judgment matrix can be built for factors in a certain hierarchy (column), and the numerical values refers to the importance of factors in vertical columns to factors in horizontal lines, shown in Table 3.

Table 3 Judgment matrix of relative importance of each indicator in first-class evaluation indicator system

	Industrial relevancy X	Specialty multiplicity M	Subject basis Z	Teaching staff J	Experimental equipment Q	Seed-money C
Industrial relevancy X	1					
Specialty multiplicity M		1				
Subject basis Z			1			
Teaching staff J				1		
Experimental equipment Q					1	
Seed-money C						1

3.4 Objective results

The objectives of this paper are, on one hand, to determine the total utility and early-warning of originally existing specialties; on the other hand, to evaluate new specialties to be set and determine the risks.

3.4.1 The total utility of originally existing specialties

Take electronic information engineering major in a certain university as an example, shown in Figure 3.

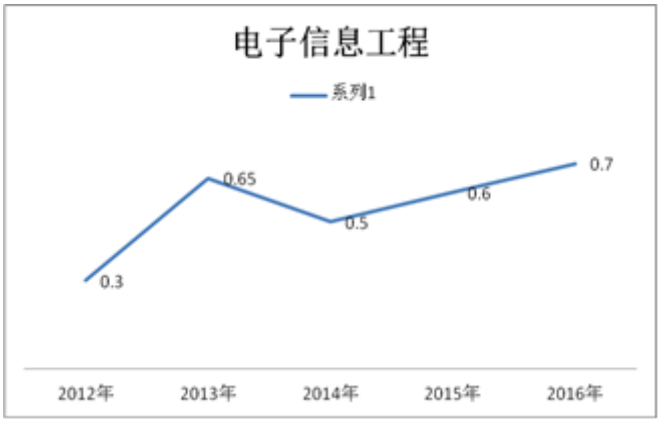

Figure 3 The tendency chart of total utility of electronic information engineering major in a certain university.

In Figure 3, the ordinate indicates the total utility of specialty. The higher the value, the higher the total utility. The change in curve value represents the change in total utility of specialty, going downwards indicating that total utility is declining; an inflection point indicates increased investment in teaching staff, equipment, books, document and other materials. If it is less than 0.5 (assumed data), the total utility of the specialty is low, which means that if the specialty continues to exist, it will waste the teaching staff, costs, etc., which is not conducive to the development of the specialty.

3.4.2 The tendency chart of new specialty setting

The total utility of newly set specialty in a certain university is shown in Figure 4.

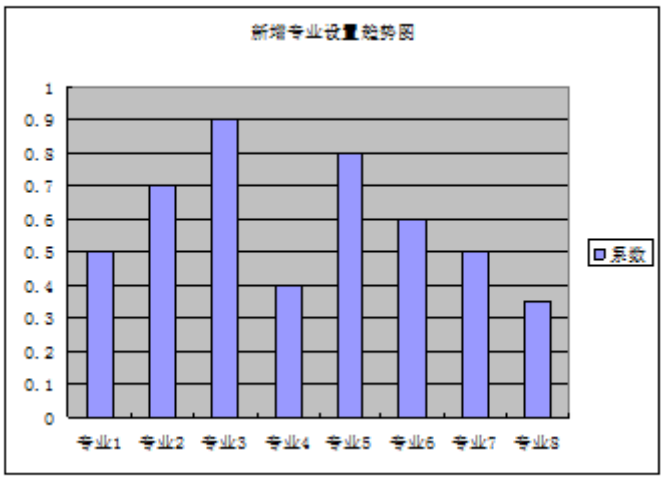

Figure 4 The tendency chart of new specialty setting

In Figure 4, the ordinate indicates the total utility of specialties. The higher the value, the higher the total utility. The abscissa refers to new specialties. If it is less than 0.5 (assumed data), the total utility of the specialty is low, which means that if the specialty continues to exist (with risks), it will waste the teaching staff, costs, etc., which is not conducive to the overall development of the university.

3.4.3 Difficulties in the results of objectives set.

There exists problem of how to determine the utility standard of specialties in objectives set in this paper, which is shown in Figure 4. How to determine the risk value of originally existing specialties or new specialties, and how to determine the standard utility value to judge the setting or retreating of originally existing specialties or new specialties, is the novelty of this paper.

3.5 Schematic diagram of internal regulation of specialty structure

In order to analyze the actual situation of originally existing specialties and new specialties in colleges and universities, this paper specifically constructs schematic diagram of specialty regulation mechanism, shown in Figure 5.

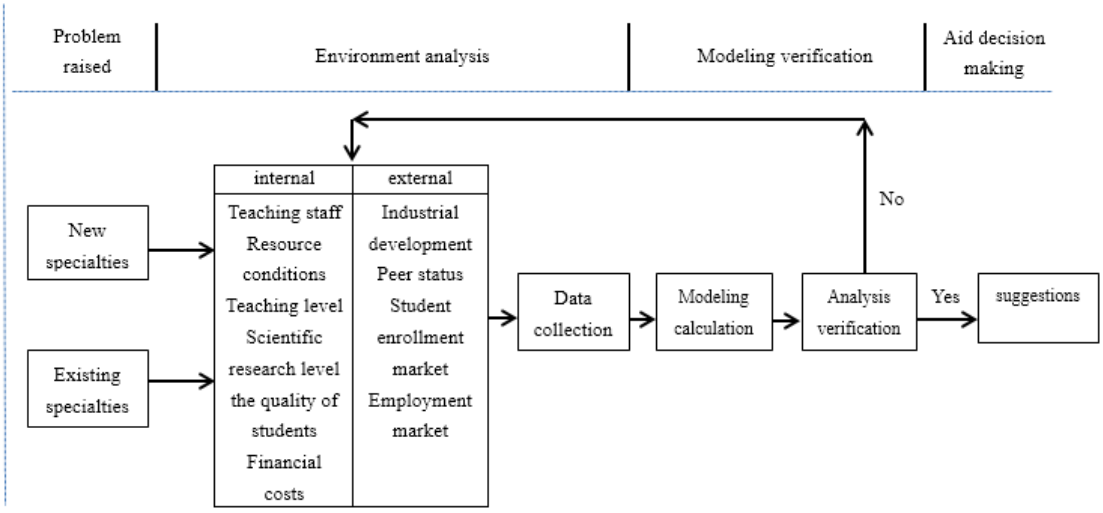

Figure 5 Schematic diagram of specialty regulation mechanism

In conclusion, the fundamental of specialty structure regulation mechanism in this paper is mainly for the evaluation analysis of originally existing specialties and new specialties in colleges and universities. The analysis on internal and external environment of a certain specialty firstly is

conducted for data collection and data mining, then analysis and verification of modeling is conducted, and factor analysis shall be performed for the verification which is inconsistent with specialty utility standard to find out reasons. If analysis and verification is consistent with specialty utility standard, suggestions shall be put forward for specialty setting [8].

Acknowledgements

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