Entropy Method and TOPSIS Combination Model Based on MATLAB Analysis of The Current Situation and Future Development Direction of the Higher Education System

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ABSTRACT

In order to evaluate the health of the higher education system and make a country's higher education system migrate to an ideal health state, we conducted a comprehensive analysis of 24 relevant indicators in 5 countries by developing a combined evaluation model of the entropy method and TOPSIS, and we chose to rank Lower China as an in-depth study object. Due to the large number of indicators involved in the model, the principal component analysis method was used for dimensionality reduction, and the principal component index scores for the past 10 years were obtained, indicating that the development speed of Chinese higher education is relatively slow and there is a large room for improvement. Next, we imagine a reasonable vision and construct an ideal and healthy higher education system, and then propose targeted improvement policies and combine a smooth prediction model to predict the index data for the next 20 years. The higher education system will be ideal by 2035. Finally, through grey relational analysis to evaluate the effectiveness of the policy, we know that the reform of higher education is long and difficult.

Keywords: *Higher Education System; Ideal Health State; Dynamic Simulation; Numerical Prediction; Policy Analysis*

1. INTRODUCTION

Higher education system not only has its own industrial value, but also can cultivate some well-trained talents, further promote the healthy and sustainable development of the economy, which is an important part of a country beyond primary and secondary education. Every country in the world has its own unique way of higher education, and each has its own advantages and disadvantages. In order to improve the country's own higher education system, the current education system needs to be evaluated to build a more healthy and sustainable higher education system.

Our goal is to develop and validate a model for evaluating and making recommendations and improvements to higher education systems in various countries. To achieve this goal, we have taken the following measures:

• Set up a set of models to measure and evaluate the world health of higher education system, select a country's higher education system for further research.

• Develop a healthy higher education system for selected country and compare the health of the current system with the proposed system, propose targeted policies and discuss policy effectiveness.

2. Higher education systematic health degree analysis

2.1. Establishment of index system and evaluation model

To assess the health of any national higher education system, we build a set of multi-function, multi-level and multi-objective comprehensive evaluation index system of higher education, the system around the student, faculty, school, community, nation on five aspects, combined with international goal [10], can really reflect

a nation's higher education system with actual state of health.

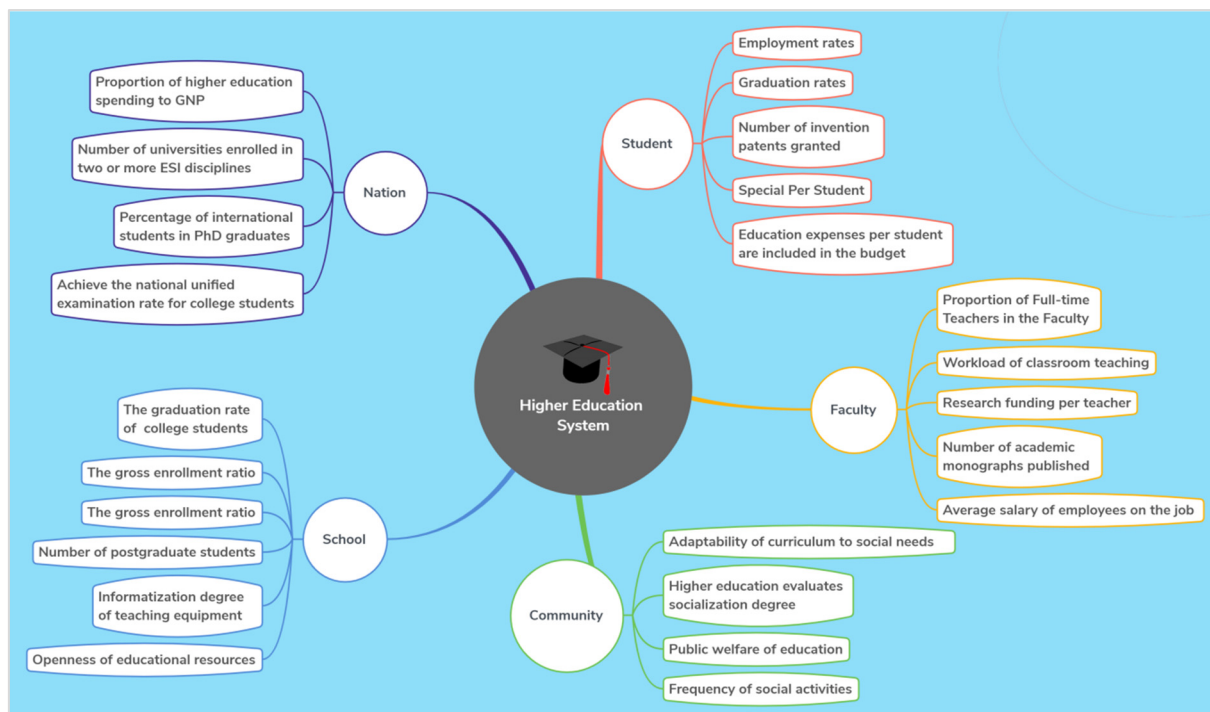The index system we constructed is shown in the following figure:

Figure 1: Comprehensive evaluation index system of higher education

According to the above indicators, in order to quantitatively represent the health status of the higher education system of various countries and make a reasonable ranking, we combined the entropy method with TOPSIS [4][7] to develop a combination evaluation model for the health status of the higher education system.

2.2. Data Dynamic Simulation

The constructed combination evaluation model needs to be validated to ensure the accuracy of data analysis.

Here, we use the method of data dynamic simulation to verify the validity of the model.

Step 1: Collect a set of reliable simulation data.

Step 2: The data of other indexes were kept unchanged, and the value of one of them was changed to obtain the parallel group data.

Step 3: The combination evaluation model was applied to multiple parallel groups of data, and MATLAB was used to calculate the graph of the comprehensive score changing with each index, as shown below:
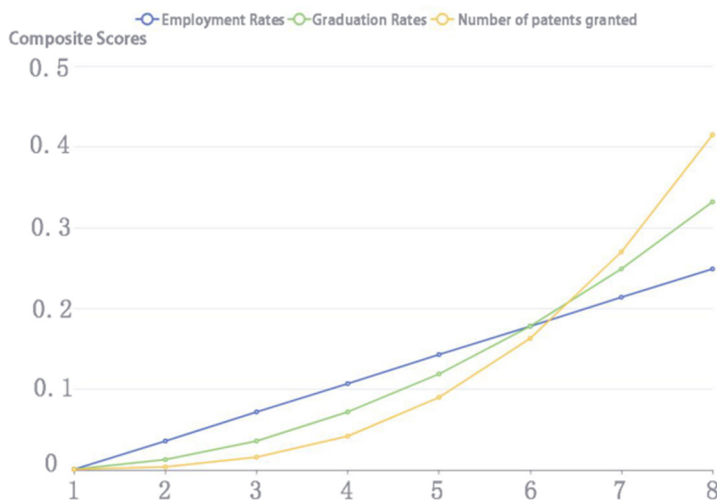

Figure 2: Changes of the comprehensive score with the change of each indicator

Where the employment rate increases linearly, so does the corresponding comprehensive score; The rate of graduation increased in the form of quadratic function, and the corresponding comprehensive score increased gradually at a slower speed, but the growth rate was larger than that of the employment rate. The number of invention patents increased as a cubic function, and the corresponding comprehensive score increased at the fastest rate. The change trend of the comprehensive score of each index corresponds to the growth degree of the index value, which is logical. Therefore, the combined evaluation model is rigorous and can effectively evaluate the health status of higher education system.

2.3. Apply to different countries

The combination evaluation model is applied to five countries, namely America, Germany, Japan, Australia and China, and the relevant data of the higher education system indicators of each country in 2021 [1] are selected. Due to the lack of some index data, some missing data were approximated by the data of related groups to obtain complete data. Then, MATLAB software was used to calculate the relative proximity of each evaluation index to the optimal value in each country, which was used to measure and compare the health status of the higher education system. The results were shown in the figure below:
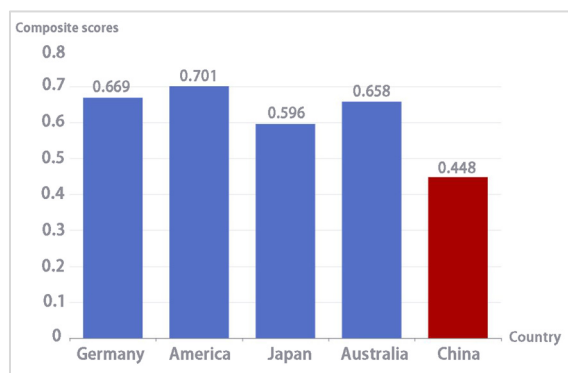
Figure 3: The value of composite scores for five countries

The higher the value of composite scores in the above table, the closer it is to the healthiest higher education system. According to the bar chart, we can intuitively know that the relative proximity degree of China's higher education system is 0.448, ranking the lowest among the five countries. Therefore, China's higher education system has relatively large room for improvement. We will choose China's higher education system for further research.

3. Research on the ideal and healthy higher education system

We take China's higher education system as the research object. In order to build a realistic and reasonable vision, it is necessary to understand the past development of China's higher education. Since it only targets one country and involves many indicators, we use principal component analysis [11] to reduce the dimensionality of multiple indicators, obtain several relatively important principal components and calculate the principal component scores by using MATLAB software, and the results are as follows:
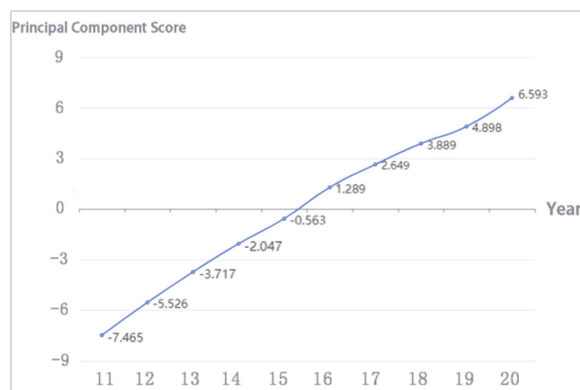
Figure 4: Principal component score changes over time

Through the analysis of the chart, the principal component score of China's higher education has been rising steadily, indicating that China's education system has been improving, but the increase is small. Therefore, we propose the vision to further improve China's higher education system.

3.1. The vision for the higher education system

① Guarantee the continuous development of financial support

The sustainable fund guarantee is the key foundation for the effective intergenerational development of colleges and universities. The meaning of intergenerational development is the future economic problem of higher education system. The successful experience of the development of higher education in developed countries is that schools should cultivate their own independent strength of funds. They not only have sufficient funds, but also can guarantee the increase in value of development funds through the investment of development funds. Therefore, China can learn from the methods of developed countries to improve the sustainable operation ability of higher education funds.

② Solve human resources issues

The problem of human resources is the key and foundation of the development of human resources in Chinese colleges and universities. Have human resources, can obtain adequate development, is the focus of its development and application. In terms of teachers in colleges and universities teaching service, if the successful college human resources management experience for reference and refined, can get the "three heart" principle, is for the school teachers, teachers don't

distract, teachers can be happy, in accordance with this principle, the school will be able to get most of the human resources development use effect.

③ Carry out institutional innovation

In the future development of institutions of higher learning, institutional innovation is an important basis for the solution of the above two problems. In the innovation of institutions of higher learning, we should break the rigid consciousness of two aspects: first, as long as the experience of foreign institutions, we cannot change; Second, as long as it is socialism with Chinese characteristics, no change can be made. Therefore, in accordance with the principle of effectiveness, the system that can effectively promote the development of China's higher education and catch up with the developed countries should adopt the attitude of support and encouragement.

Through the construction of the above vision, we guess that the indicators of China's higher education system will also change in response:

• National and social indicators will increase by 40% from the transition period to the final stage.

• 50% increase in indicator values for schools, teachers, students from transition period to final stage.

After the above changes, China's higher education system will be more perfect and develop in a healthy and sustainable way. Then, we use entropy method and TOPSIS evaluation model to evaluate China's current system and the proposed system, using MATLAB to calculate the current system of the comprehensive score $S_1=0.0057$, put forward the system of the comprehensive score $S_2=0.0426$, comparing these two values can be learned, the health status of the current system is far less than the health status of higher education system. Therefore, our proposed system can greatly improve China's higher education system and make it develop in a healthy and sustainable direction.

3.2. Policy formulation and estimation

In order for China to develop towards our proposed system, we compare the indicators of China with those of other countries and conclude that there is still room for improvement in China's economic investment and educational openness. To solve this problem, we propose the following targeted policies based on the current situation of China's education:

● Allocate more funds to marginal schools to ensure that schools have sufficient funds to improve their internal structure.

● Encourage teachers to study academic content rather than just teaching students.

● Increase the openness of education and realize the sharing of educational resources.

● Improve the comprehensive strength of the school to attract outstanding students and expand enrollment.

● Replace old equipment, improve the material conditions of education, and follow the information age.

In order to determine the implementation time of the policy, we assume that the value of relevant indicators will increase by 8% year by year under the effect of the policy, and use the one-time smoothing prediction method [9] to predict the data of various indicators in China in the next 20 years, so as to obtain the comprehensive score of health status in each year in the next 20 years, as shown in the table below:

Table1: China's overall score for the next 20 years

Year	21	22	23	24	25
Score	0.0057	0.0084	0.0111	0.0139	0.0166
Year	26	27	28	29	30
Score	0.0193	0.0220	0.0247	0.0274	0.0302
Year	31	32	33	34	35
Score	0.0329	0.0356	0.0383	0.0410	0.0437
Year	36	37	38	39	40
Score	0.0465	0.0492	0.0519	0.0546	0.0573

The graph of the growth of the comprehensive score over time is drawn according to the above table. When the curve intersects with the comprehensive score of the suggested state of health, s=0.0426, the corresponding horizontal coordinate, year=34.87, is the last stage of the suggested state, as shown in the figure below:
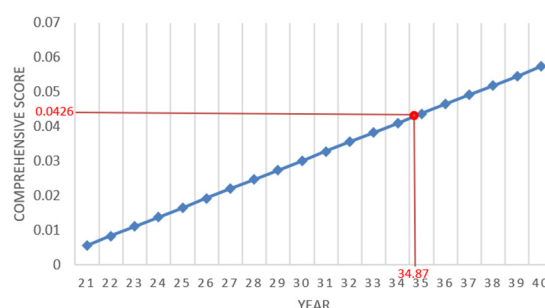

Figure 5: Comprehensive score curve of China in the next 20 years

Since 34.87 is very close to 35, in order to facilitate subsequent data processing, we take year=35 as the final stage, that is, 2035 is the last period of policy implementation. Moreover, because the policies reinforce each other, they can be implemented simultaneously.

Then the grey correlation model [8] is used to analyze the correlation degree between the indicators and the

comprehensive score, and the specific correlation degree can be obtained, as shown in the chart below:
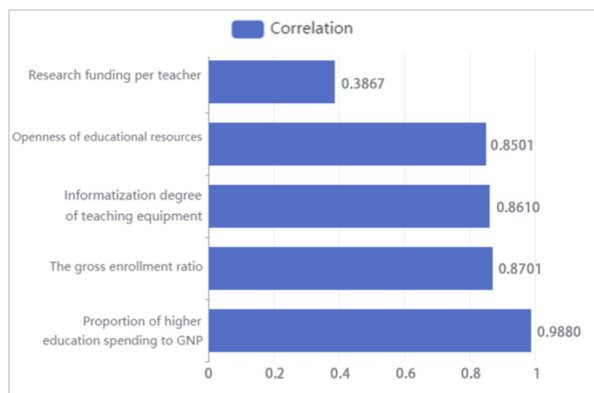
Figure 6: Correlation between the five indicators and the comprehensive score

An analysis of the above chart shows that:

--The policy of allocating more funds to marginal schools mainly affects the ratio of higher education funds to GNP, which has the highest correlation with the comprehensive score (0.988), further reflecting the high effectiveness of the policy.

--The three policies of expanding enrollment, replacing old equipment to improve the material conditions of education, and increasing the degree of openness of education affect the gross enrollment ratio, the degree of informationization of teaching equipment, and the degree of openness of education resources, respectively. The correlation level of them all exceeds 0.85, reflecting the moderate degree of effectiveness of this policy.

--Encouraging teachers to research academic content and allocating research funds affects the index of research funds per teacher, which has the lowest correlation with the comprehensive score (0.3867), reflecting the low effectiveness of this policy.

4. Model strengths and weaknesses assessment

4.1. Strengths

1. Strong inclusiveness: The topsis and entropy weight evaluation model we established contains 24 indicators, which can well represent the strength of the national higher education strength and make the model relatively reliable and inclusive.

2. Wide range of generality: The model used may seem simple, but by introducing an inclusive parameter, the model can be easily applied to every country in the world, and we can apply the model to more countries to support our article. reliability.

3. Multi-faceted applications: The national higher education strength evaluation system can not only be

used to measure the health of higher education, but also has great reference value in business and technology industries.

4.2. Weaknesses

1. Uncertainty: When we predict a healthy higher education system in the future, we ignore the impact of external conditions on us, and the entire experiment is carried out in an ideal environment.

2. Accuracy is data dependent: In our model, most of the statistics are obtained from some websites and reports, making the scores and rankings calculated by our model heavily dependent on the data.

5. CONCLUSIONS

On the basis of using MATLAB software, we have established a comprehensive evaluation system for higher education, studied the degree of perfection of the current higher education system, and selected countries with less perfect systems to propose a reasonable and reliable vision for them to build an ideal state of higher education in the future, and propose targeted policies to improve in higher education system. The final results are as follows:

—— China ranked last among the 5 countries we selected and selected it for further research.

—— Propose a vision to build an ideal and healthy higher education system in terms of capital, institutional innovation and human resources.

—— Propose five targeted policies to improve the current situation of Chinese higher education.

—— Using a smooth prediction model, it is estimated that the healthy state will be reached in 2035.

——The grey relational analysis on the effectiveness of the policy is generally effective.

Through a series of studies on higher education, we found that the level of higher education in various countries is quite different, and higher education reform is long and difficult. However, combined with the current international situation, higher education has gradually become a link that various countries attach importance to. Therefore, A country with an imperfect higher education system should spend more energy and thought on its development in order to cultivate more outstanding talents and enhance its comprehensive national strength.

REFERENCES

[1] Australian Bureau of Statistics http://www.abs.gov.au/websitedbs/d3310114.nsf/Home/Methods,%20Classifications,%20Concepts%20&%20Standards

[2] Bureau of Economic Analysis, U.S. Department of Commerce   http://www.bea.gov/bea/dn1.htm

[3] China National Bureau of Statistics http://www.stats.gov.cn/tjsj/

[4] Du Ting, Xie Xianjian, Liang Haiyan, Huang An, Han Quanfang. Comprehensive evaluation and spatial analysis of Chongqing county economy based on entropy weight TOPSIS and GIS [J]. Economic Geography, 2014, 34(06): 40-47. DOI: 10.15957/j.cnki.jjdl.2014.06.026.

[5] German Federal Statistical Office http://www.destatis.de/themen/e/thm_volksw.htm

[6] Japanese Institute of Social and Economic Research http://www.esri.cao.go.jp/index-e.html#index03

[7] Li Can, Zhang Fengrong, Zhu Taifeng, Feng Ting, An Pingli. Land use performance evaluation and correlation analysis based on entropy weight TOPSIS model [J]. Chinese Journal of Agricultural Engineering, 2013, 29(05): 217-227.

[8] Liu Luxiang, Sun Qixin, Wang Shiyun. A preliminary study on the application of grey system theory to comprehensive evaluation of new crop varieties [J]. Chinese Agricultural Science, 1989(03): 22-27

[9] Miao Kaichao. Research on price forecast of agricultural products based on exponential smoothing model [D]. Hefei University of Technology, 2009.

[10] Wu Haiyan. Research on the Evaluation Indicators of Higher Education Internationalization from the International Perspective [J]. Modern Education Management,2019,(1):124-128. DOI:10.3969/j.issn.1674-5485.2019.01.022.

[11] YUE S W. Application of principal component analysis in eco-city construction capacity evaluation [D]. Sichuan: Chengdu University of Technology,2011.