

Research on the Sustainable Development of Higher Education Based on TOPSIS Comprehensive Index System

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Abstract: The higher education system is an important factor in a country's efforts to provide its citizens with continuing education other than primary and secondary education. Based on the mathematical modeling analysis in this field, this paper first determines the three main factors that affect the healthy development of the higher education system, namely, the proportion of government education expenditure in GDP, the gross enrollment rate of higher education, and the number of well-known universities in the country. Then TOPSIS comprehensive analysis method is used to calculate the ranking of the healthy development of higher education. Moreover, take South Africa as an example to provide a good vision and policy recommendations for its development. According to the current situation of higher education in South Africa, our team put forward the "higher Education Dream Construction Policy," which made a corresponding plan to develop a very healthy higher education system in South Africa.

1. Introduction

The higher education system is an important element of a country's efforts to provide its citizens with primary and secondary education. Therefore, the higher education system has the vital value of cultivating and teaching citizens for the national economy. Different countries in the world have their characteristics of higher education [1], different higher education systems themselves have their advantages and disadvantages. We need to plan a model that can reasonably measure the healthy development of national higher education systems as an international standard to improve the higher education system in more countries to achieve prediction and policy formulation.

2. The Policy of Building Dreams in Higher Education

2.1. Factors affecting the development of higher education

The indicators to measure the healthy development of the higher education system are pluralistic. By reading 50 articles, we analyze and demonstrate the literature, exclude irrelevant factors [2], and determine that the three indicators used to measure the development of the national higher education system in this study are the ratio of government education expenditure to GDP (that is, government education investment), the gross enrolment rate of higher education and the number of famous universities included in the country.

2.2. National Choice

In order to make the results more universal, we have divided them according to different higher education systems around the world [3] and established that the research target of countries is most of the countries in Asia, Europe, Africa, North America, South America, and Oceania, in which statistics are collected, and 34 developing countries and 26 developed countries are measured. Figure 1, Figure 2:

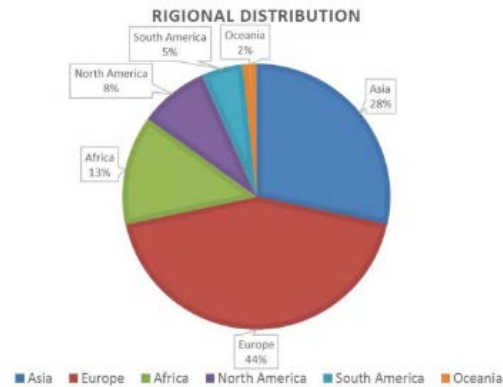


Figure 1. 34 developing countries

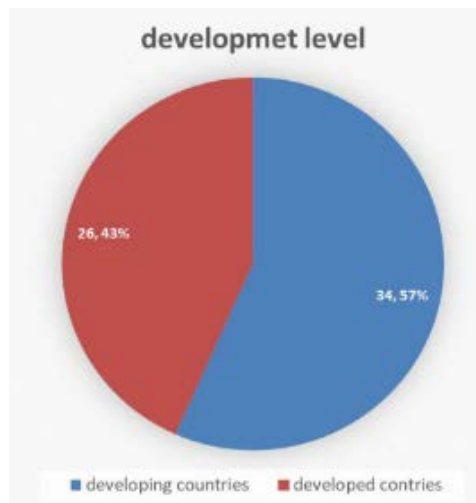


Figure 2. 26 developed countries

2.3. Explanation of Higher Education Dream Building Policy

Along with the GDP development of different countries and the progress of science and technology, the influencing factors that affect the healthy development of the higher education system have been changing [4]. According to the fitting model created by our team, the ratio of government education expenditure to GDP (that is, government education investment), the gross enrolment rate of higher education, and the number of famous universities included in the country are the three main influencing factors in the policy. For countries with higher education development systems with unhealthy and health indicators, the main three influencing factors (the same as above) are improved, and the indicators available in very healthy and healthy countries are taken as a reference [5]. Make a reasonable forecast to improve the country's development and implement the "higher education dream building policy."

3. Index system of health degree of higher education

We assume that the ratio of government expenditure on education to GDP (that is, government investment in education), the gross enrolment rate of higher education, and the number of famous universities included in the country are the three main factors in the policy. Therefore, to ensure the universality of the conclusion model, we select 60 countries to analyze and organize the data.

There are 60 evaluation objects 3 evaluation indicators, and we get a matrix, where n is 60 and m is 3:

$$\begin{bmatrix} x_{11} & \dots & x_{1m} \\ \dots & \dots & \dots \\ x_{n1} & \dots & x_{nm} \end{bmatrix} \quad (1)$$

And then, we calculate the standard values, and we get a normalized matrix:

$$q_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}} \quad (2)$$

Find the end minimum value in each column to perform the pros and cons analysis and define the maximum value $Q^+=(Q1^+, Q2^+, \dots, Qm^+)$ ($\max\{q_{11}, q_{21}, \dots, q_{n1}\}, \max\{q_{12}, q_{22}, \dots, q_{n2}\}, \dots, \max\{q_{1m}, q_{2m}, \dots, q_{nm}\},$)

Define the minimum value $Q^-(Q1^-, Q2^-, \dots, Qm^-)$ ($\min\{q_{11}, q_{21}, \dots, q_{n1}\}, \min\{q_{12}, q_{22}, \dots, q_{n2}\}, \dots, \min\{q_{1m}, q_{2m}, \dots, q_{nm}\},$)

We need to construct a rating formula: $\frac{q-Q^-}{Q^+-Q^-}$. It can be transformed into $\frac{q-Q^-}{(Q^+-q)+(q-Q^-)}$ Define the i ($i=1, 2, \dots, n$). Distance between evaluation objects and the maximum value.

$$D_i^+ = \sqrt{\sum_{j=1}^m (Q_j^+ - q_{ij})^2} \quad (3)$$

Then define the i ($i=1, 2, \dots, n$) Distance between the evaluation objects and the minimum value.

We can set three main factors: the ratio of government expenditure on education to GDP (i.e., government investment in education). The gross enrolment ratio in higher education, and the number of famous universities included in the country $m1, m2, m3$; as evaluation indicators, 60 representative countries selected for evaluation $x1, x2, x3, \dots, xn$, thus establishing a functional model and ranking the health status of higher education systems in each country, Figure 3.

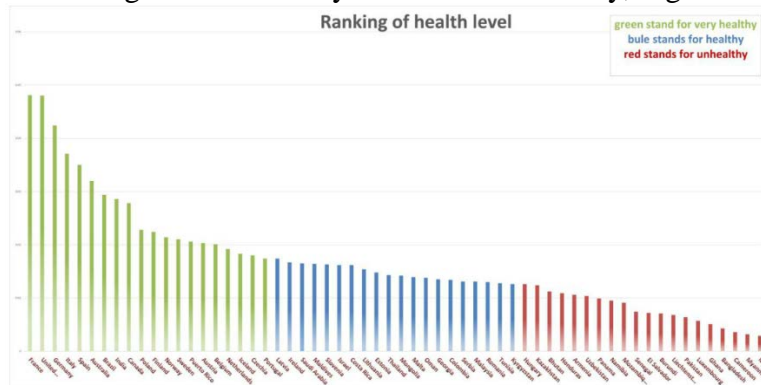


Figure 3. Model result (Data from World Statistics Pocketbook 2020 edition)

Therefore, the health status of the higher education system in different countries can be obtained by looking for three main factors of the country, using the TOPSIS comprehensive analysis method to obtain the total evaluation value, and ranking it in the ranking model of the healthy development degree of higher education. Forecast the health of the country.

4. Improvement Model and Application of Health Education system

4.1. Countries selected for testing

To test the universality of the above results, we selected 5 countries outside 60 countries, obtained the comprehensive health indicators of 5 countries according to the functional algorithm, and

determined the ranking of 5 countries in the rankings. Identify the health status of higher education systems in five countries.

It is assumed that the factors affecting the health system of higher education in five countries are the ratio of government expenditure on education to GDP (that is, government investment in education), the gross enrolment rate of higher education, and the number of famous universities included in the country. Five countries represent different world regions, and the samples are universal.

4.2. Countries selected for the use of functional algorithms

TOPSIS comprehensive evaluation method is a relative evaluation method in existing objects. In order to judge the universal possibility of model one in the world, we use the function algorithm to obtain the comprehensive evaluation data of five countries and rank it in the ranking of the healthy development degree of higher education. Firstly, using excel to collect and analyze three evaluation indicators in five evaluation countries (namely the latest data for 2020 for the three main influencing factors) as shown in figure 4:

Country	education input	gross enrollment rate	top1500 university
South Africa	6.2	27	13
New Zealand	6.4	82.4	8
Croatia	4.6	67.6	4
Qatar	2.9	26.7	0
Saint Kitts and Nevis	3.4	63.1	0

Figure 4. Three evaluation indicators in five evaluation countries

We use the TOPSIS comprehensive evaluation method to find out the ranking of the five countries in the ranking of the healthy development of higher education according to the data already listed as the target country), Figure 5(A-E) (Red is the target country):

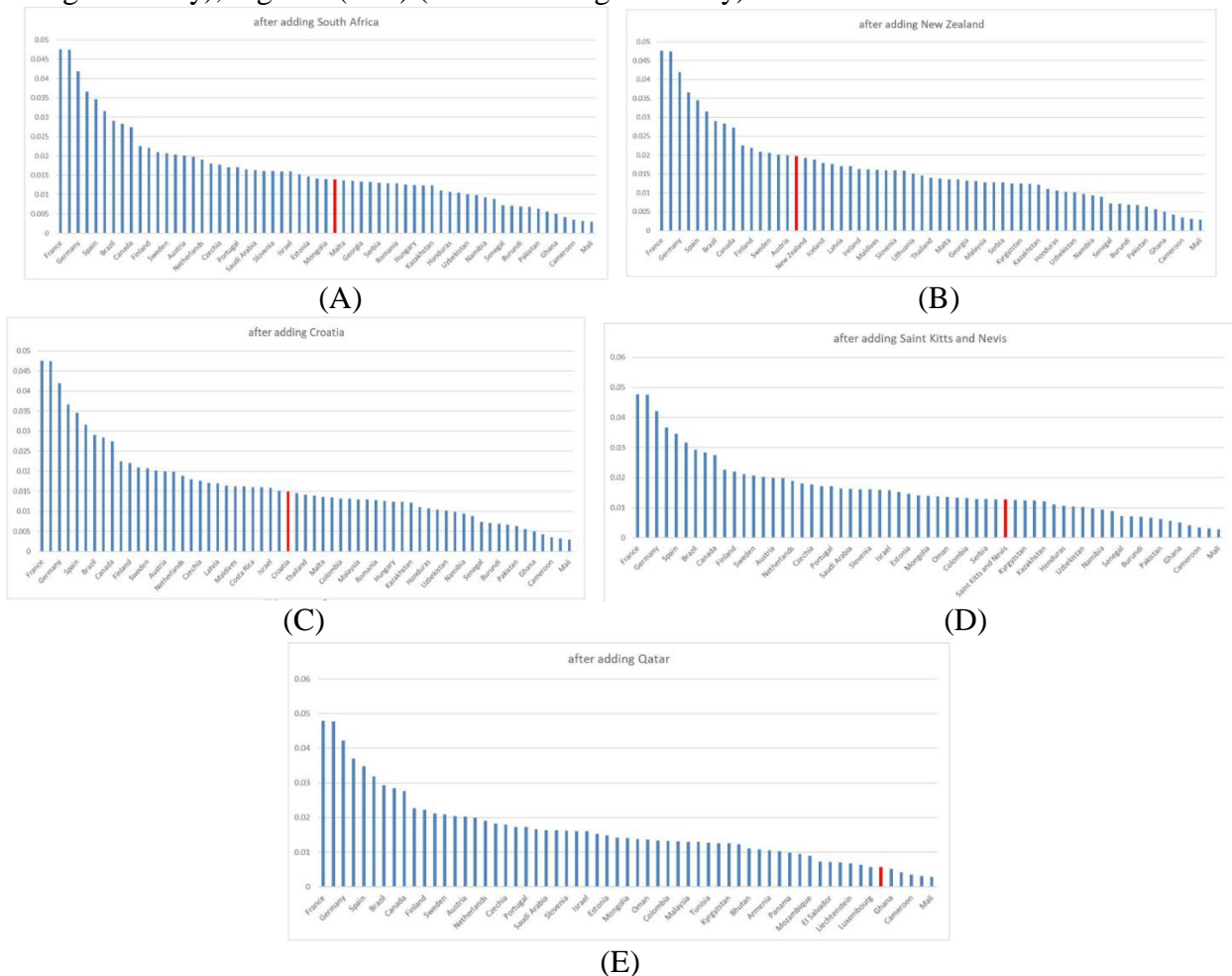


Figure 5. Model result

4.3. Reasonable vision

In the ranking of the five countries, our team chose South Africa to improve. Our team has put forward a reasonable vision for the South African region to improve the government's investment in education and the gross enrolment rate in higher education. To launch the team's "higher education dream building policy," South Africa will achieve the final target within the planned time. Government investment in education reached 6.928% in 2033, and the gross enrolment rate in higher education reached 53.94% in 2034.

5. A practical plan to achieve a very healthy vision for South Africa

5.1. Factors influencing South Africa's development space

The ratio of government expenditure on education to GDP (i.e., government investment in education), the gross enrolment rate of higher education, and the number of famous universities included in the country were statistically analyzed, and the ranking of the three indicators in the selected 60 countries was evaluated by TOPSIS comprehensive evaluation method. Figure I, O, P. for analysis (Red marked as target country, green as very health standard):

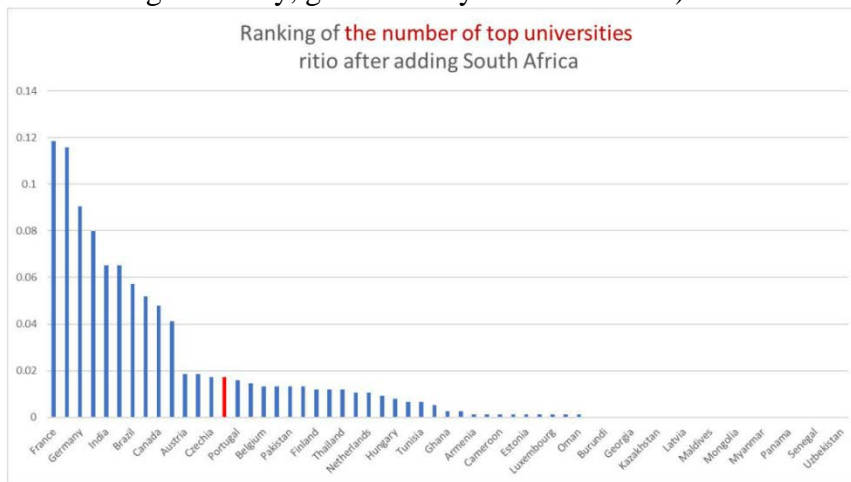


Figure 6. Ranking of the number of top universities ritio after adding South Africa

By comparing the results of Figure 7, we can judge that South Africa has a considerable number of the world's top 1500 universities, ranking the top, but there is still room for development.

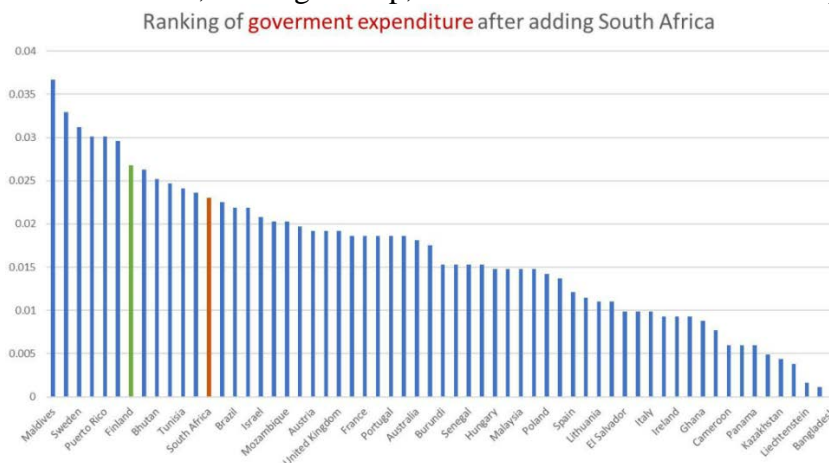


Figure 7. Ranking of government expenditure after adding South Africa

To sum up, the above three kinds of influencing factors in South Africa have their own development space. However, because the number of universities with world TOP1500 is affected by subjective factors such as rating university grades, it is not within a predictable time frame to complete the construction and construction of top universities.

5.2. Improvements in education inputs and gross enrolment ratios in South Africa

Educational input

- 1) Human investment in education: quantity and quality of higher education
- 2) Economic Development Level
- 3) Establish a Better Higher Education Finance System.

Policy recommendations for "higher education dream building ":

Policy Rule 1: On the one hand, the number of teachers in the higher education system is mainly added, and the number of school managers, teaching assistants, workers, and staff is also taken into account. On the other hand, in terms of quality, it mainly improves the standard of recruiting teachers in the higher education system, realizes the balance of supply and demand in job arrangement, realizes the rational allocation of educational resources, and improves the evaluation standard of professional title evaluation at the same time.

Policy Rule 2: At the same time, by fully developing the economy, promoting the equity of education GDP, per capita, making full use of the balanced relationship between sufficient educational investment and economic development.

Policy Rule 3: In higher education, organizers increase investment, educate share certain training costs. Colleges and universities can set up the investment mechanism of funds receiving the social donation, establish the performance evaluation mechanism of educational investment, realize the performance allocation system of combining fairness and efficiency, and perfect the tuition fee supervision and student award policy of colleges and universities.

6. Conclusions

For a country, the formation of a very healthy higher education system is of great significance to the economic development of all countries. Therefore, we need to provide healthier and more sustainable institutional policies for the healthy development of higher education systems worldwide. First of all, this paper models the determined indicators: the proportion of government education expenditure in GDP, higher education's gross enrollment rate, and the number of well-known universities in the country. According to the three-year data of influencing factors, TOPSIS comprehensive analysis method is used to calculate the ranking of the healthy development of higher education. In total, we applied the rankings of 60 countries and applied five countries outside the rankings to the model. Combined with the current situation of higher education in South Africa, our team put forward the "higher Education Dream Construction Policy." Using Matlab curve and function calculation (TOPSIS comprehensive evaluation method), it is pointed out that the development of higher education in South Africa should pay attention to the development of government investment in education and the development of gross enrollment rate of higher education, and puts forward two kinds of policy rules from the perspective of development. Time projections and policy plans have been made to develop a very healthy higher education system (implementation timetable) in South Africa.

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