

# *Research on comprehensive evaluation of education based on TOPSIS method*

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**Abstract:** Education plays an important role in social life and human society. However, in the world, due to different levels of economic development, traditional culture, values, policies and regulations, historical development and other factors, there are huge differences in the higher education system of different countries. It requires us to develop a model that can be used to evaluate the health of higher education systems in any country. We start from two angles. First, from a macro perspective, the higher education system of a country is rated by collecting relevant data of different regions, cultures and countries with different economic development in the world. Another Angle is from the perspective of classification, from the macro point of view of the country's higher education system to grade. Although the final result this method is intuitive, but only from the final score to assess its higher education system is very one-sided, so we will have the same characteristics of countries get together for a class, this not only can compare for different categories of countries, in order to optimize the its higher education system, but also the original evaluation model with partial faults are optimized. We applied the above model to 17 countries around the world, evaluated them reasonably, and selected one country with room for improvement in its higher education system -- Canada.

## **1. Introduction**

The higher education system is an important part of a country's efforts to further educate its citizens beyond primary and secondary education [1], so it is of great value as an important source of talent development. In the current world, various countries have diversified ways of higher education, actively cultivating talents and attracting international students [2, 3]. Each country's higher education system has its strengths and weaknesses, and in the context of the current pandemic, each country needs to rethink its higher education system, understand what is good, what can be improved, and then make the necessary adjustments [4]. How to adjust the policies that are implemented is the first priority for creating a healthier and sustainable system.

## **2. The comprehensive evaluation model of TOPSIS method**

TOPSIS method as a kind of comprehensive index evaluation method, the difference in such as fuzzy comprehensive evaluation method, analytic hierarchy process (ahp), its subjectivity is stronger,

don't need a target function, also do not need through the corresponding inspection, which limit requirements reduced greatly, make wider range of application, it can make full use of the information of original data, the results can accurately reflect the gap between each evaluation scheme.

Step 1: Assuming that there are  $n$  objects to be evaluated and  $m$  evaluation indicators (which have been positive), the positive matrix composed of them is as follows:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix}$$

Step 2: The matrix to which it is normalized is denoted by  $Z$ . A standardized matrix with  $n$  objects to be evaluated and  $m$  evaluation indexes is obtained:

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix}$$

Step 3: Define the distance between the  $i$ th ( $i = 1, 2, \dots, n$ ) evaluation object and the maximum value

$$D_i^+ = \sqrt{\sum_{j=1}^m (Z_j^+ - z_{ij})^2}$$

Define the distance between the  $i$ th ( $i = 1, 2, \dots, n$ ) evaluation object and the minimum value

$$D_i^- = \sqrt{\sum_{j=1}^m (Z_j^- - z_{ij})^2}$$

Step 4: The unnormalized score of the  $i$ th ( $i = 1, 2, \dots, n$ ) evaluation object was calculated:

$$S_i = \frac{D_i^-}{D_i^+ + D_i^-}$$

In order to reduce the cultural differences between different continents may interfere with the modeling results. In addition, we intentionally select sample countries according to their economic development level, so that the selection can more intuitively reflect the actual situation and avoid the problem that the model's application scope is too small due to the same economic development level of sample countries. We selected 17 countries such as India, USA, China, Brazil, Russia, Japan, Mexico, Iran, France, Indonesia, Britain, Portugal, Australia, Germany, Egypt, Thailand, Canada as the source of data. These countries are distributed in all continents of the world and represent various cultural and economic development levels.

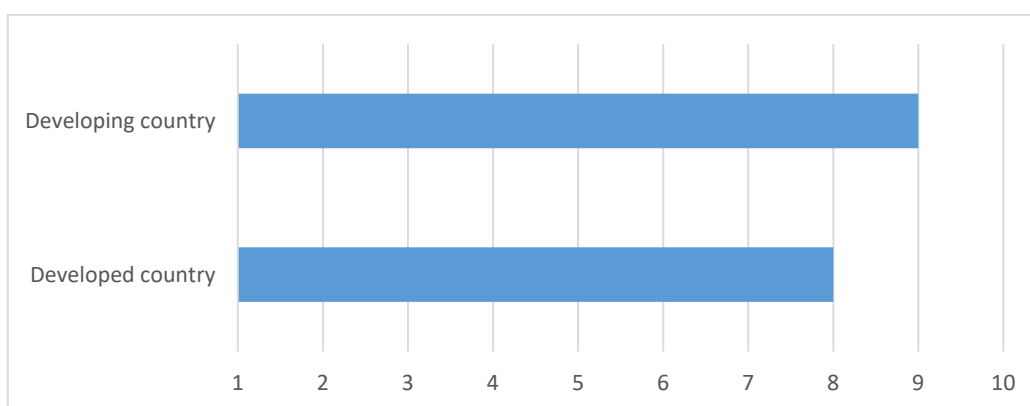


Figure 1: Developed and developing countries in the sample

For an assessment of a higher education system, we selected the following indicators: the number of universities, GDP, the education Index, knowledge economy index, education spending as a percentage of GDP, Top 500 universities in the world, the proportion of higher education population, gross enrollment ratio.

Table 1: Data description statistics

	Cases	Range	Min	Max	average value Statistics	Standard error
No. of Universities	17	8376	34	8410	1472.71	558.269
Research expenditure(USD100mn)	17	5723	7	5730	1030.71	435.635
GDP(trillion)	17	21.143	.287	21.43	3.75212	1.362177
educational indicator	17	.454	.473	.927	.72894	.032479
Knowledge Economy Index(KEI)	17	5.86	3.06	8.92	6.3641	.54780
Education expenditure (percentage of GDP)	17	3.2	3.0	6.2	4.529	.2098
Number of top 500 universities in the world	17	85	1	86	19.18	5.516
Proportion of higher education in total population(Age 25-64)%	17	53	8	61	31.24	4.405
Gross enrollment rate	17	64.24	26.07	90.31	56.6794	4.80366
Number of effective cases (listed)	17					

Calculate the polymerization coefficient and draw the line chart of the polymerization coefficient.

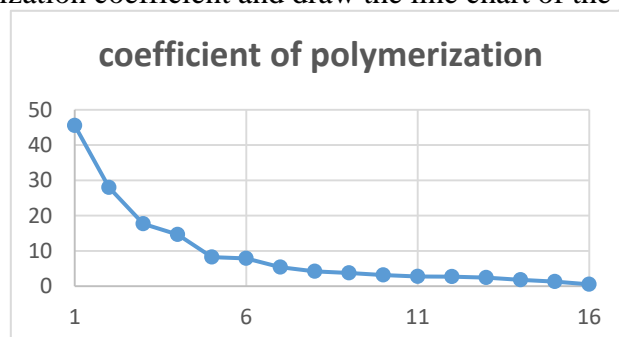


Figure 2: Polymerization coefficient line chart

As shown in the line chart of the polymerization coefficient, when the number of categories is 3, the trend of the broken line decreases slowly, so the number of categories can be set to 3.

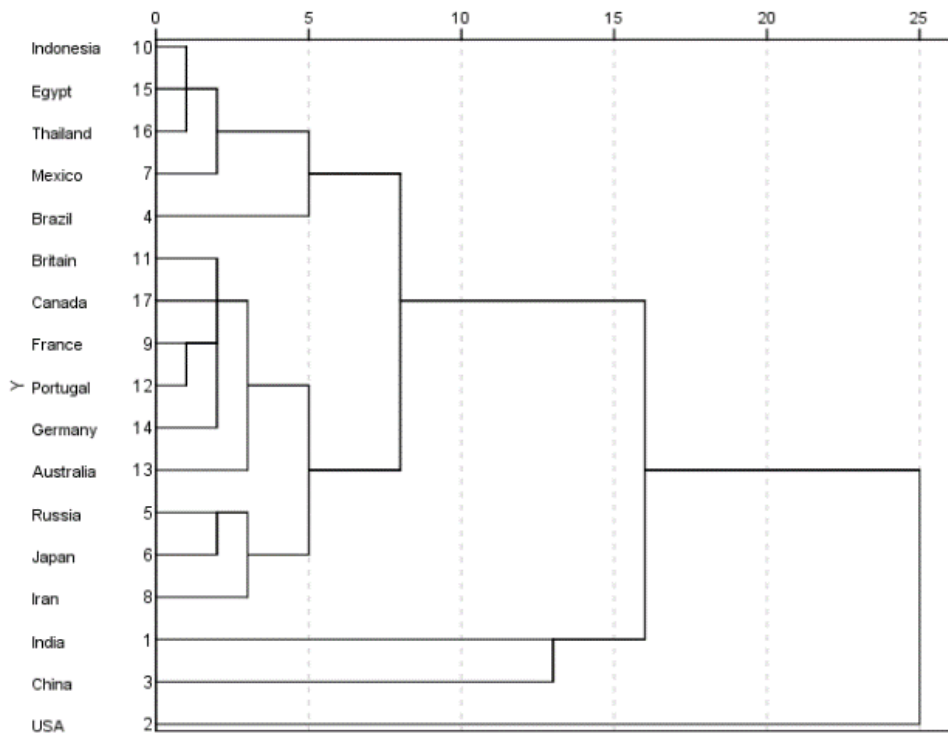


Figure 3: Hierarchical Diagram

According to the observation of the pedigree chart, the country in the first category is the United States. The country in this category has a large amount of educational resources and all indicators are in good condition, so we evaluate its higher education system as excellent. The second category includes Canada, the United Kingdom, etc. The number of institutions of higher learning in this category of countries is at the middle level, but the relevant indicators are in good, we evaluate their higher education system is good. Countries in the third category include China and India. Due to the large educated population base, these countries have a large number of institutions of higher learning, but the relevant evaluation indicators are unbalanced. Therefore, we evaluate their higher education system as unbalanced higher education system.

The TOPSIS model was used for evaluation:

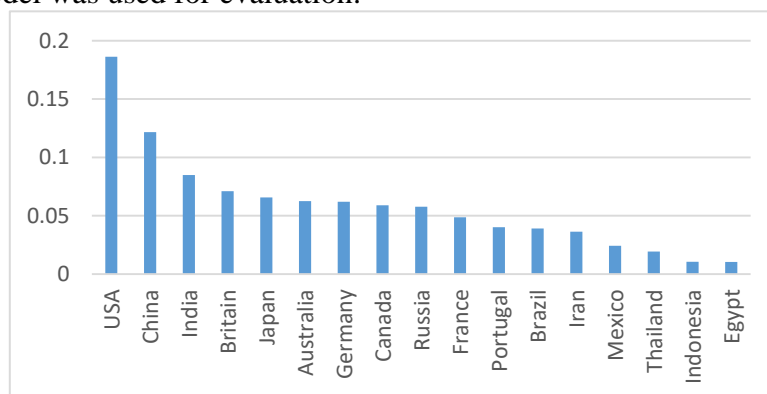


Figure 4: Score of national higher education system

### 3. Conclusion

Through comprehensive analysis of the above two models, it can be seen that Canada is below the average in the solution results of the two models, which indicates that its higher education system is unbalanced and imperfect. Therefore, we choose Canada as the object of analysis for the following topics.

### References

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