# The Evaluation Model of the Higher Education System Based on AHP and Entropy Method

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**Abstract.** This paper uses the entropy weight method and analytic hierarchy process (AHP) to establish a model to evaluate the health status of higher education in various countries, calculate the score, and obtain its corresponding health status. The model sets up three inner circle evaluation indexes and three outer circle auxiliary indexes, which evaluate the health status of higher education from different dimensions and in different ways. We split and combine the two methods to calculate the weight and comprehensive score of the indicator, and finally divide the health status according to the score obtained. After scoring and ranking, it is concluded that higher education in India is unhealthy. According to the model, we propose policies to implement in India to meet the healthy state.

**Keywords:** Analytic Hierarchy Process (AHP) · entropy method · evaluation

## 1 Introduction

A higher education system is an important element in a nation's efforts to further educate its citizens beyond a required primary and secondary education. Due to various factors, the development of higher education systems in various countries is very different, and each has its advantages and disadvantages.

We assessed the health of the national higher education system and chose a nation to propose targeted policies and an implementation timeline.

## 2 Model Establishment and Solution

### 2.1 Choice of Indicators

We divide the higher education system into two systems: the inner circle and the outer circle. The inner circle is the evaluation system, which participates in the evaluation process of the higher education system. The outer circle is the influence system, which influences the higher education system, but does not participate in the scoring and evaluation process. As shown in Fig. 1, the function of the inner circle is to score, and its indicators are divided into scientific research and innovation ability, social service capacity, and talent training ability. The role of the outer circle is to serve as a significant


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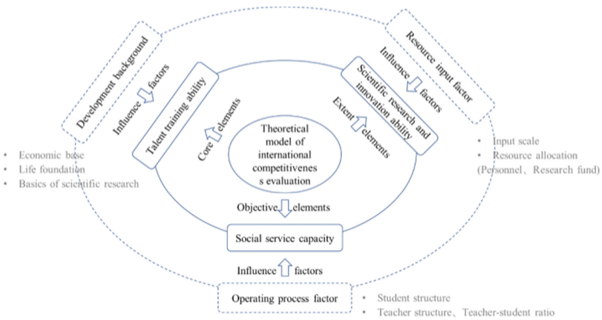


**Fig. 1.** The theoretical model of the higher education analysis system

**Table 1.** The introduction of each level indicators

| Factor | First level indicators | Second level indicators | Sign |
|---|---|---|---|
| F1 | Scientific research and innovation ability | the number of ESI paper | X5 |
| | | highly cited papers | X6 |
| | | total cites | X7 |
| | | hot papers | X8 |
| | | the ratio of ARWU top 500 | X9 |
| | | THE top university | X10 |
| F2 | Social service capacity | UIC | X11 |
| | | the number of patent filings per million population | X12 |
| F3 | Talent training ability | gross enrollment rate of higher education | X1 |
| | | proportion of working-age population with higher education | X2 |
| | | proportion of PhD students | X3 |
| | | research and development personnel per 1,000 employment | X4 |

indicator for the specific analysis of the health status of higher education in the country and assist in the formulation and planning of policies [1].

To make the scoring process easier to operate and feasible, we divided the three first-level indicators in the inner circle into 12 s-level indicators, as shown in Table 1.

Since we selected 12 secondary indicators, the units of each indicator are very different, and the difference of each indicator is too large, so we convert the data of each indicator into a score with a full score of 100 points. We set the largest one in the data as $X_{\max}$, and then we process all the data according to this formula:

$$X_i' = X_i/X_{\max} * 100\% \tag{1}$$

This score serves as the basis for judging the health of higher education in various countries.

For the selection of twelve secondary indicators, we refer to the article competitiveness of higher education in countries along with the "Belt and Road" Research on Level Measurement and Related Factors [5]. All data in this study come from statistical reports or public databases of international authoritative organizations. The time node is mainly in 2019, or it can be supplemented in adjacent years. Among them, "the number of ESI papers", "highly cited papers", "total cited", and "hot papers" are all from ESI based on the seven index databases (SCI, SSCI, A&HCI, etc.) of the Web of Science core collection. Data; "the number of patent filings per million population" and "UIC" are from the World Economic Forum (WEF) "Global Competitiveness Report 2019"; "the ratio of ARWU top 500" and "THE top university" are respectively from Shanghai Jiao Tong University And Times Higher Education (THE) website; "gross enrollment rate of higher education", "proportion of the working-age population with higher education", "proportion of Ph.D. students", "Proportion of teachers' salaries to expenditures of higher education institutions" data comes from the World Bank Education Statistics Database, The "government governance effectiveness ranking" comes from the World Bank's Global Government Governance Index (WGI); the "research and development personnel per 1,000 employment" comes from the online data of the UNESCO Institute of Statistics (UIS Statistics).

### 2.2 Determining the Weight with the Combination of AHP and Entropy Method

Firstly, we determine the weights. Then we give the score through the formula:

$$\text{score} = \text{W1} * \text{F1} + \text{W2} * \text{F2} + \text{W3} * \text{F3} \tag{2}$$

which is the basis for measuring the health status of higher education. Finally, rank the countries with the score descending.

We use the AHP to determine the weights. Now we have the first method, whose Weight selection is based on AHP models with the same factor importance. However, there is strong subjectivity in simply using the AHP in method 1. The entropy method is more objective than the AHP method, which can reduce the errors of subjective judgment and prevent the information from losing its authenticity. We calculate the weights at this time as W1' = 0.695, W2' = 0.152, W3' = 0.153, and a score is obtained by the formula above as a measure of higher education health. The basis of the situation is recorded as the Entropy method, and a ranking situation is calculated from high to low according to the Entropy method (method 2), marked as rank 2, for more intuitive comparison with other methods, and rank1 is also listed next to it. As shown in Table 2, the difference in the rank obtained by the two methods is very large in many countries [3].

Due to the large difference between the previous AHP model and the entropy method model with the same importance, we need to re-select the weight optimization model so that the data obtained by the AHP model is more in line with the objective situation. After many attempts and considerations, we think that the importance ratio of F1:F2 = 1/0.4, F1:F3 = 1/0.4, F2:F3 = 1/2 is the most appropriate, and construct the judgment matrix in Table 3. After consistency check, CR $<$ 0.1, indicating that this importance ratio is established, the running results are as follows: W1" = 0.64, W2" = 0.13, W3" = 0.24.

We find that the difference between method 2 and method 3 is very small, and the difference does not exceed 2, so the AHP model at this time has been more in line with the objective situation, and the optimization of the model has also reached a certain effect. Considering that the health level of higher education cannot rely solely on objective data or subjective opinions. Although the entropy method fully excavates the information

**Table 2.** Difference between AHP and entropy method

| | COUNTRY | F1 | F2 | F3 | M2 | R1 | R2 | difference |
|---|---|---|---|---|---|---|---|---|
| 1 | USA | 100.00 | 84.26 | 74.06 | 93.66 | 1 | 1 | 0 |
| 2 | CHINA MAINLAND | 59.97 | 54.85 | 48.88 | 57.50 | 12 | 2 | 10 |
| 3 | UK | 39.42 | 76.77 | 71.94 | 50.06 | 2 | 3 | 1 |
| 4 | GERMANY (FED REP GER) | 26.58 | 86.65 | 65.55 | 41.67 | 4 | 4 | 0 |
| 5 | FRANCE | 18.32 | 76.46 | 68.88 | 34.87 | 13 | 7 | 6 |
| 6 | CANADA | 17.93 | 76.26 | 65.82 | 34.11 | 14 | 8 | 6 |
| 7 | ITALY | 17.73 | 24.87 | 58.98 | 25.09 | 30 | 20 | 10 |
| 8 | AUSTRALIA | 18.67 | 78.75 | 87.64 | 38.32 | 3 | 6 | 3 |
| 9 | JAPAN | 20.79 | 82.37 | 75.20 | 38.45 | 5 | 5 | 0 |
| 10 | SPAIN | 15.33 | 54.18 | 70.16 | 29.59 | 20 | 12 | 8 |
| 11 | NETHERLANDS | 12.00 | 86.25 | 73.70 | 32.70 | 7 | 9 | 2 |
| 12 | SOUTH KOREA | 11.35 | 79.98 | 77.67 | 31.90 | 10 | 10 | 0 |
| 13 | SWITZERLAND | 9.27 | 75.80 | 71.53 | 28.88 | 16 | 14 | 2 |
| 14 | INDIA | 12.04 | 35.73 | 38.26 | 19.64 | 34 | 29 | 5 |
| 15 | SWEDEN | 8.08 | 87.67 | 75.00 | 30.39 | 9 | 11 | 2 |
| 16 | BELGIUM | 6.59 | 76.71 | 72.47 | 27.30 | 17 | 17 | 0 |
| 17 | DENMARK | 5.53 | 85.43 | 80.06 | 29.05 | 8 | 13 | 5 |
| 18 | IRAN | 7.83 | 17.28 | 49.19 | 15.56 | 39 | 34 | 5 |
| 19 | AUSTRIA | 5.12 | 71.06 | 71.69 | 25.30 | 18 | 19 | 1 |
| 20 | SINGAPORE | 3.84 | 78.45 | 76.81 | 26.31 | 15 | 18 | 3 |
| 21 | POLAND | 5.21 | 43.28 | 65.47 | 20.18 | 25 | 27 | 2 |
| 22 | RUSSIA | 7.67 | 39.96 | 63.59 | 21.10 | 26 | 23 | 3 |
| 23 | NORWAY | 3.74 | 81.05 | 81.63 | 27.37 | 11 | 16 | 5 |
| 24 | FINLAND | 3.75 | 87.57 | 81.69 | 28.38 | 6 | 15 | 9 |
| 25 | TURKEY | 6.66 | 35.12 | 67.64 | 20.27 | 28 | 26 | 2 |
| 26 | PORTUGAL | 3.82 | 50.51 | 74.77 | 21.73 | 22 | 22 | 0 |
| 27 | SAUDI ARABIA | 4.49 | 47.71 | 57.71 | 19.17 | 27 | 30 | 3 |
| 28 | GREECE | 3.08 | 39.66 | 84.24 | 21.00 | 23 | 24 | 1 |
| 29 | SOUTH AFRICA | 3.88 | 39.86 | 39.10 | 14.72 | 36 | 36 | 0 |
| 30 | NEW ZEALAND | 3.33 | 69.12 | 70.73 | 23.61 | 19 | 21 | 2 |
| 31 | CZECH REPUBLIC | 3.42 | 57.75 | 63.27 | 20.81 | 24 | 25 | 1 |
| 32 | MEXICO | 3.28 | 32.88 | 44.58 | 14.07 | 37 | 38 | 1 |
| 33 | MALAYSIA | 2.86 | 53.78 | 43.09 | 16.74 | 31 | 32 | 1 |
| 34 | EGYPT | 3.26 | 24.06 | 42.99 | 12.47 | 40 | 40 | 0 |
| 35 | CHILE | 3.09 | 38.13 | 52.90 | 16.00 | 32 | 33 | 1 |
| 36 | HUNGARY | 2.03 | 47.91 | 53.89 | 16.91 | 29 | 31 | 2 |
| 37 | THAILAND | 2.43 | 32.93 | 50.00 | 14.32 | 35 | 37 | 2 |
| 38 | ROMANIA | 2.20 | 34.81 | 53.50 | 14.98 | 33 | 35 | 2 |
| 39 | COLOMBIA | 1.63 | 28.60 | 46.35 | 12.54 | 38 | 39 | 1 |
| 40 | SLOVENIA | 0.91 | 62.29 | 66.07 | 20.18 | 21 | 28 | 7 |

**Table 3.** Judgment matrix (method 3)

| | F1 | F2 | F3 |
|---|---|---|---|
| F1 | 1 | 2.5 | 2.5 |
| F2 | 0.4 | 1 | 0.125 |
| F3 | 0.4 | 0.8 | 1 |

in the original data, it cannot reflect our own experience and knowledge. Although the AHP method makes full use of our experience and knowledge, it still loses a certain degree of objectivity and authenticity. Therefore, we decided to combine the entropy method with the AHP method to obtain a method that conforms to objective facts and exerts subjective experience, as method 4. The final weight is W = 0.5*W' + 0.5*W'', using W' (W1' = 0.695, W2' = 0.152, W3' = 0.153) in the entropy method model and W'' (W1'' = 0.64, W2'' = 0.13, W3'' = 0.24) in the AHP model after optimization, and taking the average to calculate the final weight. Finally, we determine the formula of the score as:

$$\text{score} = 0.663\text{F1} + 0.141\text{F2} + 0.196\text{F3} \quad (3)$$

The score is used as the final criterion for judging the health of higher education and is shown in Table 4.

### 2.3 Analysis and Determination of Health Condition

We have independently determined four levels: very healthy, healthy, sub-healthy, and unhealthy. Observation data. We can find that the scores of the United States are very high, which is far from the data of other countries. So, we decided to classify the United States separately as very healthy. Observing data from various countries outside the United States, the data is relatively close, and the difference is not large. They can be compared with each other as a measure.

To better compare the health status of other countries, we chose China with the second score as the standard value, denoted as $Y_{\max}$, and other countries as $Y_i$. According to the formula:

$$Y_i' = Y_i / Y_{\max} * 100\% \quad (4)$$

$Y_I$' is determined as the final score S. The results are listed in Table 4.

We have created a standard to measure scores based on the scores of countries as shown in Table 5. Then, the scores of each country are classified and combined using this standard, as shown in Table 6.

Finally, we analyze the results. The United States monopolizes the very healthy ladder. The level of higher education in the United States is very high. The top 500 universities in the ARWU world account for about one-third, the total number of ESI papers, the number of highly cited papers, the number of hot papers, etc. The data is also much higher than that of other countries, among which Harvard University ranks first in the world rankings of major universities. It shows that the U.S. investment in higher education is very effective. The U.S. has strong capabilities in the three aspects of higher education research and innovation capabilities, higher education social service capabilities, and higher education talent training capabilities. The advantages of American higher education are obvious and are the absolute leader in higher education and scientific research.

The countries with a healthy higher education level obtained in our model are mainly developed countries or larger developing countries. These countries are not much different from the United States in terms of higher education social service capabilities and higher education talent training capabilities, but there is a certain distance between the research and innovation ability of higher education and the United States, which is reflected in the fact that the proportion of the top 500 universities in the world is much lower than that of the United States. The total number of ESI papers, the number of high-cited papers, and the number of hot papers are low. Through the calculation and analysis of F1 data, it is found that the scores of other countries are below 60. The gap is mainly derived from this, and the weight F1 we use also accounts for the majority, so

**Table 4.** Modified score and ranking

| | COUNTRY | F1 | F2 | F3 | M4 | R4 | S |
|---|---|---|---|---|---|---|---|
| 1 | USA | 100.00 | 84.26 | 74.06 | 93 | 1 | very healthy |
| 2 | CHINA MAINLAND | 59.97 | 54.85 | 48.88 | 57 | 2 | 100.00 |
| 3 | UK | 39.42 | 76.77 | 71.94 | 51 | 3 | 89.36 |
| 4 | GERMANY (FED REP GER) | 26.58 | 86.65 | 65.55 | 43 | 4 | 74.67 |
| 5 | FRANCE | 18.32 | 76.46 | 68.88 | 37 | 7 | 63.68 |
| 6 | CANADA | 17.93 | 76.26 | 65.82 | 36 | 8 | 62.13 |
| 7 | ITALY | 17.73 | 24.87 | 58.98 | 27 | 20 | 46.91 |
| 8 | AUSTRALIA | 18.67 | 78.75 | 87.64 | 41 | 5 | 71.06 |
| 9 | JAPAN | 20.79 | 82.37 | 75.20 | 40 | 6 | 70.17 |
| 10 | SPAIN | 15.33 | 54.18 | 70.16 | 32 | 12 | 55.15 |
| 11 | NETHERLANDS | 12.00 | 86.25 | 73.70 | 35 | 9 | 60.38 |
| 12 | SOUTH KOREA | 11.35 | 79.98 | 77.67 | 34 | 10 | 59.43 |
| 13 | SWITZERLAND | 9.27 | 75.80 | 71.53 | 31 | 14 | 53.89 |
| 14 | INDIA | 12.04 | 35.73 | 38.26 | 21 | 30 | 35.89 |
| 15 | SWEDEN | 8.08 | 87.67 | 75.00 | 32 | 11 | 56.61 |
| 16 | BELGIUM | 6.59 | 76.71 | 72.47 | 29 | 17 | 51.32 |
| 17 | DENMARK | 5.53 | 85.43 | 80.06 | 31 | 13 | 54.82 |
| 18 | IRAN | 7.83 | 17.28 | 49.19 | 17 | 34 | 30.17 |
| 19 | AUSTRIA | 5.12 | 71.06 | 71.69 | 28 | 19 | 47.94 |
| 20 | SINGAPORE | 3.84 | 78.45 | 76.81 | 29 | 18 | 50.02 |
| 21 | POLAND | 5.21 | 43.28 | 65.47 | 22 | 27 | 39.09 |
| 22 | RUSSIA | 7.67 | 39.96 | 63.59 | 23 | 24 | 40.50 |
| 23 | NORWAY | 3.74 | 81.05 | 81.63 | 30 | 16 | 52.20 |
| 24 | FINLAND | 3.75 | 87.57 | 81.69 | 31 | 15 | 53.84 |
| 25 | TURKEY | 6.66 | 35.12 | 67.64 | 23 | 26 | 39.50 |
| 26 | PORTUGAL | 3.82 | 50.51 | 74.77 | 24 | 22 | 42.42 |
| 27 | SAUDI ARABIA | 4.49 | 47.71 | 57.71 | 21 | 29 | 36.69 |
| 28 | GREECE | 3.08 | 39.66 | 84.24 | 24 | 23 | 42.13 |
| 29 | SOUTH AFRICA | 3.88 | 39.86 | 39.10 | 16 | 37 | 27.69 |
| 30 | NEW ZEALAND | 3.33 | 69.12 | 70.73 | 26 | 21 | 45.06 |
| 31 | CZECH REPUBLIC | 3.42 | 57.75 | 63.27 | 23 | 25 | 39.82 |
| 32 | MEXICO | 3.28 | 32.88 | 44.58 | 16 | 38 | 27.14 |
| 33 | MALAYSIA | 2.86 | 53.78 | 43.09 | 18 | 32 | 31.29 |
| 34 | EGYPT | 3.26 | 24.06 | 42.99 | 14 | 40 | 24.41 |
| 35 | CHILE | 3.09 | 38.13 | 52.90 | 18 | 33 | 31.05 |
| 36 | HUNGARY | 2.03 | 47.91 | 53.89 | 19 | 31 | 32.57 |
| 37 | THAILAND | 2.43 | 32.93 | 50.00 | 16 | 36 | 28.03 |
| 38 | ROMANIA | 2.20 | 34.81 | 53.50 | 17 | 35 | 29.41 |
| 39 | COLOMBIA | 1.63 | 28.60 | 46.35 | 14 | 39 | 24.78 |
| 40 | SLOVENIA | 0.91 | 62.29 | 66.07 | 22 | 28 | 38.97 |

**Table 5.** Scoring criteria

| Health condition | Very healthy | Healthy | Sub-healthy | Not healthy |
|---|---|---|---|---|
| Interval | USA | 60-100 | 36-60 | <36 |

there will be such a big gap. They have some relatively competitive universities, such as Oxford and Cambridge in the UK, or Tsinghua University in China, which are very competitive internationally. They also have good educational resources and investments, but they are still not as good as the United States.

Sub-healthy and unhealthy countries have relatively low data for each item. Mainly speaking, their economic strength is relatively lacking, and there is a gap between their GDP and other countries. There is not much money invested in educational development, whether in universities or the data. All aspects are in the catch-up stage. These countries may not pay much attention to higher education and do not have too much energy to develop higher education, so some policies need to be formulated to improve [6].

**Table 6.** Classification of higher education system health status

| | |
|---|---|
| Very healthy | USA |
| Healthy | CHINA MAINLAND, UK, GERMANY, AUSTRALIA, JAPAN, FRANCE, CANADA, NETHERLANDS |
| Sub-healthy | SWEDEN, DENMARK, SWITZERLAND, FINLAND, NORWAY, BELGIUM, SINGAPORE, AUSRIA, ITALY, NEW ZEALAND, PORTUGAL, GREECE, RUSSIA, CZECH REPUBLIC, TURKEY, POLAND, SLOVENIA, SAUDI ARABIA |
| F3 | INDIA, HUNGARY, CHILE, IRAN, ROMANIA, THAILAND, SOUTH AFRICA, MEXICO, COLOMBIA, EGYPT |

**Table 7.** Classification of higher education system health status

| Factor | peripheral indicators | Reference factors |
|---|---|---|
| M1 | Development background | Economic base |
| | | Life foundation |
| M2 | Resource input factors | Input scale |
| | | Resource allocation(Personnel, Research fund) |
| M3 | Operating process factors | Student structure |
| | | Teacher structure |

## 3 Country Analysis and Policy Proposal

According to the results in Table 4, India is unhealthy. Therefore, we choose India to analyze.

It can be seen from the establishment of the model that the indicator corresponding to F1 is the ability to cultivate talents in higher education, and this indicator in India is at a medium level and has a lot of room for growth; the indicator corresponding to F2 is the ability of social services in higher education, and India's performance in this indicator At the low-medium level, the index corresponding to F3 is the scientific research and innovation ability of higher education, and India's performance on this index is at a low level.

Peripheral indicators (M1, M2, M3) are used as influential indicators when specifically analyzing the health status of higher education in the country. Next, we will use these three indicators to specifically analyze the status of higher education in India and support participation in policy formulation and plan (Table 7).

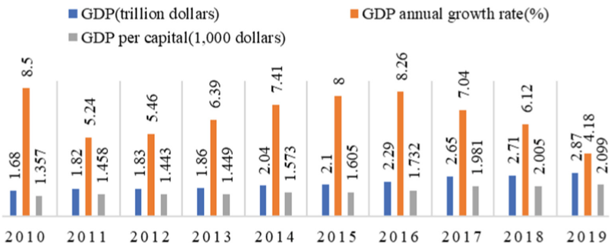


**Fig. 2.** 2010–2019 India's GDP

**Table 8.** Classification of higher education system health status

| Year | Gross enrollment rate | Boy enrollment rate | Girl enrollment rate |
|---|---|---|---|
| 2009 | 16.11 | 13.21 | 18.77 |
| 2010 | 17.91 | 14.97 | 20.62 |
| 2011 | 22.87 | 19.99 | 25.50 |
| 2012 | 24.37 | - | - |
| 2013 | 23.89 | 23.07 | 24.64 |
| 2014 | 25.54 | 25.31 | 25.74 |
| 2015 | 26.88 | 26.73 | 27.00 |
| 2016 | 26.93 | 26.96 | 26.90 |

## 3.1 Peripheral Indicators

### 3.1.1 Higher Education Development Background

#### 3.1.1.1 Economic Basis

From 2010 to 2019, India's total GDP has shown a continuous growth trend, but there is still much room for improvement in terms of annual GDP growth rate and per capita GDP (Fig. 2).

#### 3.1.1.2 Student Basis

From 2009 to 2016, India's higher education enrollment rate showed a continuous growth trend. As a result, higher education in India has entered a stage of popularization. It is gradually facing the general public to pass knowledge to Indian citizens. This also reflects the Indian government's emphasis on higher education (Table 8).

### 3.1.2 Higher Education Resource Input Factors

The development of higher education institutions Since independence, the number of higher education institutions in India has increased significantly. As of 2016, the number of universities in India had increased to 799, and the number of colleges had grown to 39,071. The number of universities and colleges has grown rapidly, and the number of State Public universities is significantly higher than that of other types of universities.

### 3.1.3 Higher Education Operation Process Factors

#### 3.1.3.1. Student Structure

Higher Education Enrollment In the 2015–2016 academic year, more than 31 million students in India entered higher education institutions (including 27.42 million undergraduates, 3.91 million postgraduates, and 120,000 doctoral students), increasing more than 320,000 from the previous academic year people. In 2014, the number of college students in India surpassed that of the United States, becoming the second-largest higher education system globally. The number of undergraduates, masters, and doctoral students admitted to Indian universities has increased year by year. In terms of the distribution of academic qualifications, undergraduates accounted for 87%, while graduate students and doctoral students accounted for 12.6% and 0.4%, respectively.

#### 3.1.3.2 Teacher Structure

The number of college teachers in India during the 2015–2016 academic year increased from 12,274,453 in the 2011–2012 academic year to 1,518,813. The number of teachers has increased year by year, and the increase is mainly at the lecturer level. Taking the 2015–2016 school year as an example, there are 146,021 professors (10.4%), 1,174,657 associate professors (12.4%), and 1,09,196 lecturers (71.7%) among the teachers at all levels of professional titles in Indian universities [2].

## 3.2 Propose Policy and Implementation Time

We selected the seven most weighted indicators in the model, combined with the above educational background, and proposed a series of policies and their implementation time in Table 9.

### 3.2.1 Capital Investment to Build More Universities and the Real-World Impact

This policy will take 20 years and a large amount of capital investment to establish 2 Central Universities, 1 Institute of National Importance, 2 State Public Universities, 2 Deemed Universities-Government, and 1 Deemed University-Government Aided, a total of 8 universities. Increase the gross enrollment rate of higher education at an annual growth rate equal to 1.17%, reaching a gross enrollment rate of 52.00 in 2041.1.1. At the same time, it can also promote the growth of the proportion of the working-age population with higher education and the number of R&D personnel per thousand employments, which will reach the values of 64.00 and 5.8 respectively in 20 years.

This policy has enabled India to have more schools to accommodate more students, and at the same time, increase the employment rate of teachers. However, a large amount of capital investment is required, and economic results cannot be achieved in the short term, which is a great burden for a country in the development period. At the same time, a large amount of capital investment in education may lead to a short-term decline in GDP and unemployment, which harms the increase of the gross enrollment rate [4].

**Table 9.** Policy proposal and timetable

| policy | indicators | Initial value | Initial score | Value | Score | Realization time |
|---|---|---|---|---|---|---|
| Capital investment to build more universities | gross enrollment rate of higher education | 28.57 | 20.00 | 52 | 36.4 | 2041.1 |
| Increase the enrollment rate of elementary and secondary | proportion of working-age population with higher education | 59.94 | 67.61 | 64 | 72.2 | 2041.1 |
| | research and development personnel per 1,000 employment | 3.4 | 15.34 | 5.8 | 26.2 | 2041.1 |
| Increase the proportion of Ph.D. students | proportion of PhD students | 27.99 | 42.86 | 35 | 53.6 | 2031.1 |
| | the number of ESI paper | 694350 | 15.82 | 2800000 | 63.78 | 2031.1 |
| Encourage Ph.D. students through funding | highly cited papers | 5081 | 6.48 | 30000 | 38.3 | 2031.1 |
| | total cites | 7507299 | 8.56 | 30000000 | 34.2 | 2031.1 |

### 3.2.2 Increase the Enrollment Rate of Elementary and Secondary Education and the Real-World Impact

This policy is supplementary to Policy 1 and has the same time limit as Policy 1. The enrollment rate of elementary and secondary education can be increased through the promulgation of bills related to the number of years of compulsory education, and the base of higher education students can be improved, thereby promoting the gross enrollment rate of higher education, the growth of the proportion of the working-age population with higher education and the number of R&D personnel per thousand employments.

This policy can make higher education popular, no longer confined to serving the upper-class elites, but gradually opening up to the general public, allowing Indian citizens to enjoy educational opportunities. However, the auxiliary effect of this policy is limited. At the same time, an overly aggressive policy will arouse negative emotions among the people, and their long-term attitude towards education will not make them easy to change.

### 3.2.3 Increase the Proportion of Ph.D. Students and the Real-World Impact

The policy took ten years to increase the proportion of doctoral students by seven percentage points through capital investment, increase the number of doctoral programs, expand the recruitment of doctoral supervisors, and issue subsidies for doctoral programs to the school. At the same time, the total number of ESI papers will be increased to 2,800,000, the number of highly cited papers will be increased to 30,000, and the total number of ESI papers cited will be increased to 30,000,000.

People's long-term attitudes towards education will not change easily. Even if the capacity of doctoral students is increased, being a Ph.D. reading will still not be the first choice for those who are unwilling to do before. And a higher proportion of doctoral students means that the market labor force will be reduced in the short term, which is unacceptable to a country in a developing period. In addition, the proportion of doctoral students matches the level of scientific development. If you want to increase the proportion of doctoral students in this nation, you must also consider its level of scientific development.

### 3.2.4 Encourage Ph.D. Students Through Funding and the Real-World Impact

This policy is supplementary to Policy 3 and has the same time limit as Policy 3. Grants, scholarships, tuition reductions, and other methods can be used to give preferential treatment to Ph.D. students, which can increase the attractiveness of Ph.D. students.

The supplementary ceiling of this policy is limited. It can only increase the attractiveness of Ph.D. reading but cannot significantly change the attitude of Ph.D. reading in people's minds. Moreover, the government-issued funds are slight compared with the income from labor, and becoming a Ph.D. compared with a bachelor will not have obvious preferential treatment in future life.

# 4 Conclusion

## 4.1 Advantages

The model is divided into multiple indicators for easy quantitative calculation. The model decomposes the higher education evaluation system that seems difficult to evaluate and divides it into three inner indicators for scoring and three outer auxiliary indicators for analysis. At the same time, the internal indicators continued to be split to form 12 secondary indicators, making the evaluation of the higher education system easy to quantify and measure its health status.

The policies and suggestions put forward are reliable and effective. When analyzing a specific country's higher education rating system, you can make full use of the peripheral indicators in the higher education evaluation system. Through the analysis of the peripheral indicators, you can get the factors that affect the health of the higher education system, and then put forward targeted suggestions.

The model calculation method is continuously optimized and improved. The model starts with the calculation of weights such as the analytic hierarchy process, using entropy method to test, and then adjusts the weights in the analytic hierarchy process, and uses it in combination with the entropy method to continuously improve the model and evaluate the health status from the initial prototype. The results also tend to be correct and reliable.

## 4.2 Disadvantages

The selection of indicators is still somewhat one-sided. As an important part of social life, the higher education system is bound to be affected in many ways. Although the indicators selected in this article are as comprehensive as possible, they still have certain limitations.

The analytic hierarchy process used in the model is easily affected by the subject's concept. The weights involved in the analytic hierarchy process are presented through manual scoring, which will inevitably be affected by subjective emotions. The calculation results of the model will inevitably produce certain calculation errors, which may affect the results.

### 4.3 Improvement

Increase the analysis dimension. By consulting relevant information or research, increase the evaluation index, making the model's results more scientific and referential.

Use expert scoring method. To prevent experts from scoring too subjectively, multiple groups of experts can be cross-scored, and then the consistency test can be used to make the scoring results of several groups of experts no longer change so that the scores obtained are more scientific, and the calculated weights are more effective convince.

## References

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