

Higher education evaluation system based on AHP & EWM

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Abstract: As the scope of mental work continues to expand and technology continues to develop, people are more and more concerned about the issue of higher education. In order to measure the health status of the higher education system and evaluate the effectiveness of the policy, we establish the Health Evaluation System of Higher Education and the Prediction Model. task 1 In order to better quantify the criteria of health evaluation, we divide the model into four layers through AHP algorithm, select and define 13 fourth-layer indicators, and use Entropy Weight Method (EWM) to objectively calculate the fourth-layer indicators. The Analytic Hierarchy Process (AHP) is used to calculate the third-level weight. According to the population of different countries, we use the complex method of AHP and EWM and scale the indicator to create a scoring mechanism. In task 2 We firstly apply the model to a number of countries to test its suitability, and the results are in good agreement with the education assessment lists published by the United Nations. And we find that India is a country where there is still room for improvement in the education system. task 3 We propose an attainable and reasonable vision for India's system that supports a healthy and sustainable system of higher education. task 4 According to the scores of India in various indicators and the total score obtained in task 2, we judge that the score of India is unqualified. task 5 We select three of the lowest scores in India's higher education system out of 13 indicators, and propose targeted policies and a implementation timeline that will support the migration from current state to your proposed state. task 6 We establish a prediction model based on ARIMA, and substitute time series data into the prediction model to obtain the prediction results. Then, we use AHP and EWM algorithms to calculate the first-level targets for comparison, so as to evaluate the effectiveness of the policies. task 7 We reference and analyze the various situations in India and the real world impact of the implementation plan, find that the change is very difficult, and analyze the feasibility of the policy.

1. Introduction

1.1. Background

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The development level of higher education is an important symbol of a country’s development level potential. It also provides solid talent and intellectual support for improving people’s life and realizing sustainable development. Our need for higher education is more urgent than ever, and our desire for scientific knowledge and outstanding talents is stronger than ever. Throughout the world, there are various higher education systems with different effects, but the purpose is often unified. In the face of the complex situation and global problems of the world economy, the international community is increasingly becoming a lifeline of the whole, and higher education is absolutely worthy of in-depth discussion. Therefore, it is a pressing matter of the moment for us to measure and evaluate the higher education system of all countries, to extract the essence and discard the dross, so as to establish a universal, healthy and sustainable higher education system, to serve science and technology, train talents, and promote the rapid development of society.

1.2. Our Work

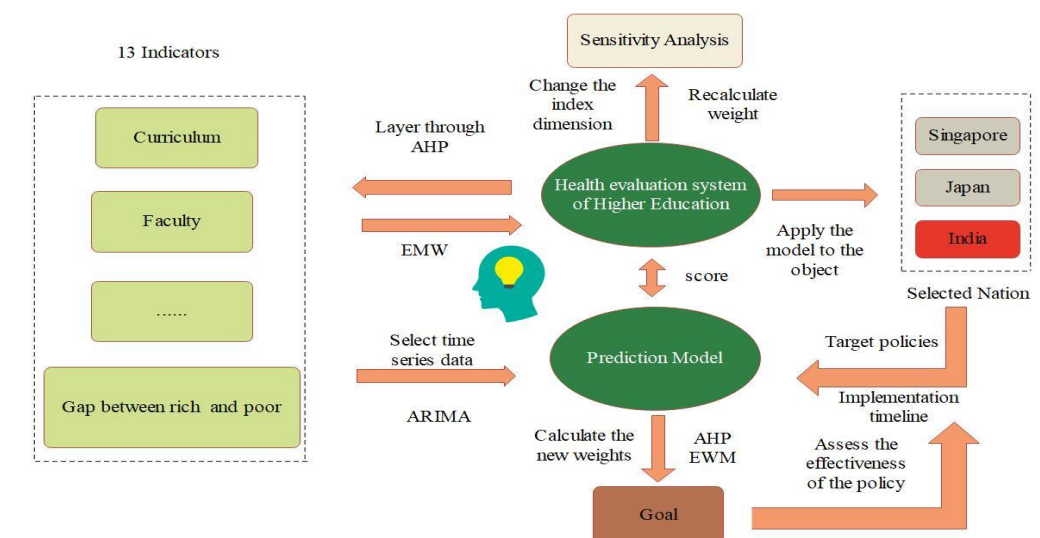


Figure 1: Technology route for the creation of our paper

In order to determine the health of any country’s higher education system, we establish a Health Evaluation System of Higher Education. By selecting the appropriate evaluation index, the index weight is given. The model was applied to each country to test its applicability. India, which has more room for improvement, is selected to put forward and analyze a series of policies, as shown in Figure 1.

We will complete the following work:

- 1) Measure the health of India’s higher education system.
- 2) Establish a prediction model based on ARIMA.
- 3) Predict the situation of India without policy intervention and by policy intervention in 10

years.

- 4) Evaluate the effectiveness of the policy by comparing the two sets of data in 3).
- 5) A sensitivity analysis will be made for the Health Evaluation System of Higher Education.
- 6) The real-world implications of implementing the plan will be discussed.
- 7) Discuss the strengths and weaknesses about our model.

2. Assumptions

In order to quantify the given problems and make the model more suitable for simulating the real situation, we make the following assumptions.

- There is no correlation between the indicators and they cannot affect each other
- The selected countries want to improve their health through policies
- The implementation of the policy is free from external factors and unexpected circumstances
- In search engines, the number of search results for a certain keyword represents the degree of people’s concern about this matter
- Reaching more beneficiaries and locations will automatically enhance the impact of a healthy, sustainable higher education system initiative

This assumption is based on the belief that the size, number of beneficiaries or geographic locations covered constitutes an indicator of an initiative’s success and positive influence on people.

3. Analysis

In order to evaluate the health degree of higher education system more specifically, we divide a education system into the following aspects.

3.1. Quality of education

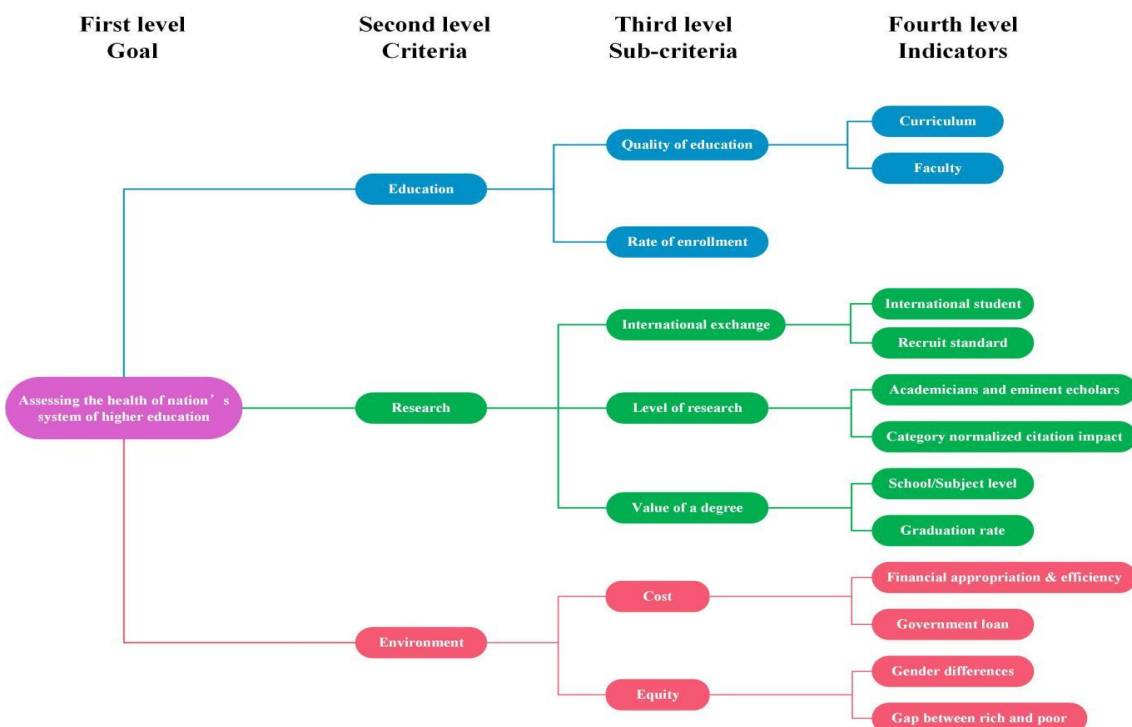


Figure 2: The indexes

- Curriculum

Curriculum design includes curriculum structure and curriculum content. Whether the curriculum content is reasonable and whether the courses are well connected is closely related to whether students can fully acquire the knowledge and ability required by a certain major, as shown in Figure 2.

- Faculty

Teachers and administrators at a school are one of the human resource factors that affects teaching quality.

3.2. Rate of enrollment

Enrollment rate refers to the percentage of the total number of students enrolled in higher education who continue to receive education after graduation.

3.3. Rate of enrollment

- International students

Students who have crossed national or regional boundaries for the purpose of studying and are currently studying outside the home country. The number of these students reflects the degree of communication between the local education system and the international environment.

- Recruit standard

The rules formulated by universities to maximize the learning benefits of exchange students and the overall level of target university students.

3.4. Level of research

- Academicians and eminent scholars

Generally hired by the school to lead the research track of the school subject with senior qualifications and act as a part of the senior teacher of the subject facade.

- Category normalized citation impact

Compared with the peer papers (published in the same year, the same discipline, the same type of Literature), it is an index to reflect the citation of papers.

3.5. Value of a degree

- School/Subject level

A school or subject level can objectively reflect the value of a degree through information collection and verification, subjective evaluation, and weight determination.

- Graduation rate

The graduation rate reflects the number and basic quality of qualified students cultivated by a certain stage of education or school within a specified time limit according to the specified goals; the drop out rate and repetition rate in a given period of time are inversely proportional to the graduation rate on time; the utilization efficiency of educational resources and the graduation rate on time are inversely proportional to the average educational resources of students in the corresponding period of time. Therefore, it is an important indicator to measure the value of an academic degree.

3.6. Cost

- Financial appropriation & efficiency

The financial input and financial efficiency of the country to education reflect the attitude of the country to education and the degree of recognition of the school. Here we will use a fiscal cost efficiency estimation model to measure fiscal efficiency.

$$CE(x, q, w) = \frac{c(q, w)}{w^T x} \quad (1)$$

$$C(q, w) = \min\{w^T x : f(x) \geq q\} \quad (2)$$

Where cost efficiency (CE) is measured by the ratio of actual costs to actual costs. w represents a certain input factor, q represents a certain amount of output, and x is the input vector.

- Government loan

In the face of high tuition fees or their own circumstances of poverty, loose loan policy can help students finish their studies, reflecting the health and humanistic care of the education system.

3.7. Equity

- Gender differences

School education is an important embodiment of gender equity, but in the current education system, there are still gender bias and gender discrimination, including the difference in the enrollment rate of male and female students and the difference in curriculum setting, which hinder the realization of education equity.

- Gap between rich and poor

Uneven allocation of educational resources is a common phenomenon in the existing education system. According to the level of economic development of the region, the input of human, material and financial resources obtained by schools is quite different. Especially in poor areas, students are often difficult to receive normal education.

4. Model of health evaluation system

4.1. The establishment of the model

To evaluate the health of an education system, we divide the factors mentioned above into target layer, system layer and index layer. And use AHP to establish a health evaluation system.

Analytic hierarchy process (AHP) is put forward by Professor Saaty of University of Pittsburgh in the early 1970s by using network system theory and multi-objective comprehensive evaluation method. This method divides the evaluation factors into three levels: objective, criterion and scheme, and makes decision on the basis of qualitative and quantitative analysis. Based on the analysis of the essence, influencing factors and hierarchical relationship of complex decision-making problems, this paper uses less quantitative information to mathematicize the decision-making thinking process, so it is suitable for solving this problem.

Table 1: Saaty's nine importance levels

Scale	Comparison of importance
1	Equally important
3	A little more important
5	Important
7	Obviously important
9	Absolutely important

• Construct judgment matrix

First of all, we compare the relative importance of the two indicators with Saaty's nine importance levels and their assignments, and use them as the numerical unit of the judgment matrix.

Then we search each index on Bing, and through the number of entries retrieved, we can understand the public's concern for a certain aspect, thus determine the importance of the index. Finally, the judgment matrix of the system layer is constructed.

$$\begin{bmatrix} 1 & 2.21 & 3.72 & 1.55 & 0.96 & 0.75 & 1.79 \\ 0.45 & 1 & 1.68 & 0.7 & 0.43 & 0.34 & 0.81 \\ 0.27 & 0.6 & 1 & 0.42 & 0.26 & 0.2 & 0.48 \\ 0.65 & 1.43 & 2.4 & 1 & 0.62 & 0.48 & 1.15 \\ 1.04 & 2.33 & 3.85 & 1.61 & 1 & 0.78 & 1.87 \\ 1.33 & 2.94 & 5 & 2.08 & 1.28 & 1 & 2.39 \\ 0.56 & 1.23 & 2.08 & 0.87 & 0.53 & 0.42 & 1 \end{bmatrix}$$

• Weight determination

We use the arithmetic average method, geometric average method and eigenvalue method to calculate the relative weight, thus ensure the stability and accuracy of the data. In the process of consistency judgment, we use the formula CR = to calculate the consistency ratio and pass the consistency test.

Result of arithmetic average method:

$$[0.1886 \quad 0.0851 \quad 0.0508 \quad 0.1219 \quad 0.1965 \quad 0.2518 \quad 0.1053]$$

Result of geometric average method:

$$[0.1886 \quad 0.0851 \quad 0.0508 \quad 0.1219 \quad 0.1965 \quad 0.2518 \quad 0.1053]$$

Result of arithmetic average method:

$$[0.1886 \quad 0.0851 \quad 0.0508 \quad 0.1219 \quad 0.1965 \quad 0.2518 \quad 0.1053]$$

Finally, we use the entropy weight method to determine the index weight of the index layer. According to the concept of entropy weight method, the greater the discrete degree of data itself, the greater the impact on the overall evaluation; the smaller the discrete degree of data itself, the smaller the impact on the overall evaluation. Therefore, the result obtained by entropy weight method is relatively objective, as shown in Figure 3 and Figure 4.

The specific steps are as follows:

1) Normalization treatment of index

Positive index

$$x'_{ij} = \frac{x_{ij} - \min\{x_{1j}, \dots, x_{nj}\}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad (3)$$

Target layer	system layer	W_{BA}	index layer	W_{CB}
Health evaluation system of Higher Education A	Rate of enrollment $B1$	0.1886		
	Equity $B2$	0.0851	Gender differences $C1$	0.526
	Value of degree $B3$	0.0508	Gap between rich and poor $C2$	0.474
			School/Subject level $C3$	0.4722
	Cost $B4$	0.1219	Graduation rate $C4$	0.5278
			Financial appropriation&efficiency $C5$	0.5649
	Level of research $B5$	0.1965	Government loan $C6$	0.4351
			Academicians and eminent scholars $C7$	0.4265
	Quality of Education $B6$	0.2518	Category normalized citation impact $C8$	0.5735
			Curriculum $C9$	0.4456
	International exchange $B7$	0.1053	Faculty $C10$	0.5544
			International students $C11$	0.551
			Recruit standard $C12$	0.4489

Figure 3: Weight of each index 1

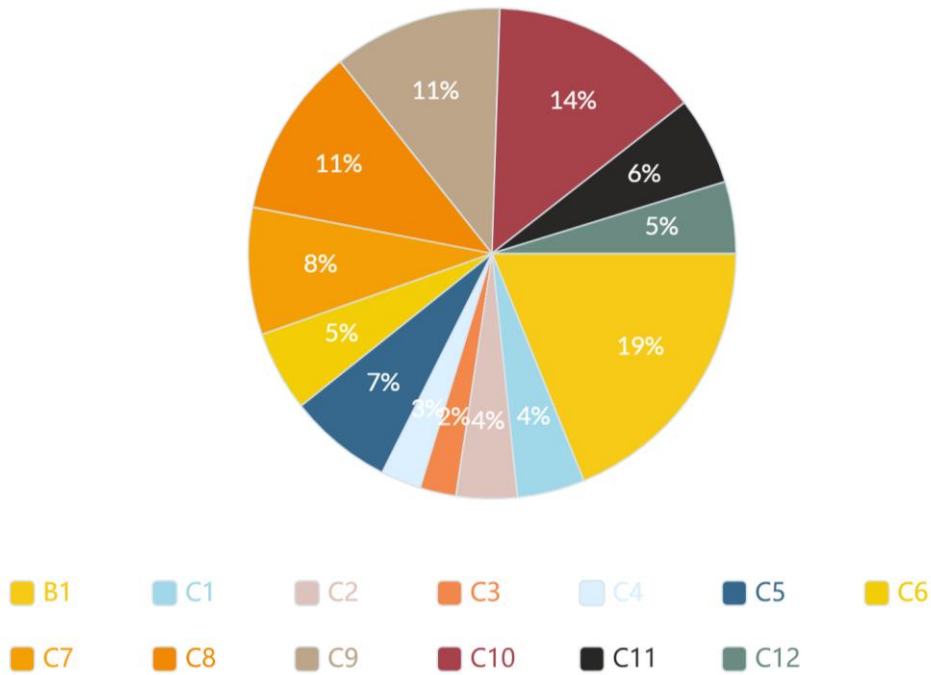


Figure 4: Weight of each index 2

Negative index

$$x'_{ij} = \frac{\max\{x_{1j}, \dots, x_{nj}\} - x_{ij}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}} \quad (4)$$

2) Calculate the proportion of indicators to the total

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}} \quad (5)$$

3) Calculate the entropy of the index

$$e_j = -k \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad (6)$$

$$k = \frac{1}{\ln(n)} > 0 \quad (7)$$

4) Computing entropy redundancy

$$d_j = 1 - e_j \quad (8)$$

5) Calculate the weight of indicators

$$w_j = \frac{d_j}{\sum_{j=1}^m d_j} \quad (9)$$

Where P is the proportion of indicators to the total, e is the entropy of the index, d is the entropy redundancy and w is the weight of the indicators.

4.2. Application of the model

First of all, we use the health assessment system to evaluate some countries in the world and get their health level. In order to show the results more intuitively, we reflect them on the map. The results are consistent with the objective facts, as shown in Figure 5.

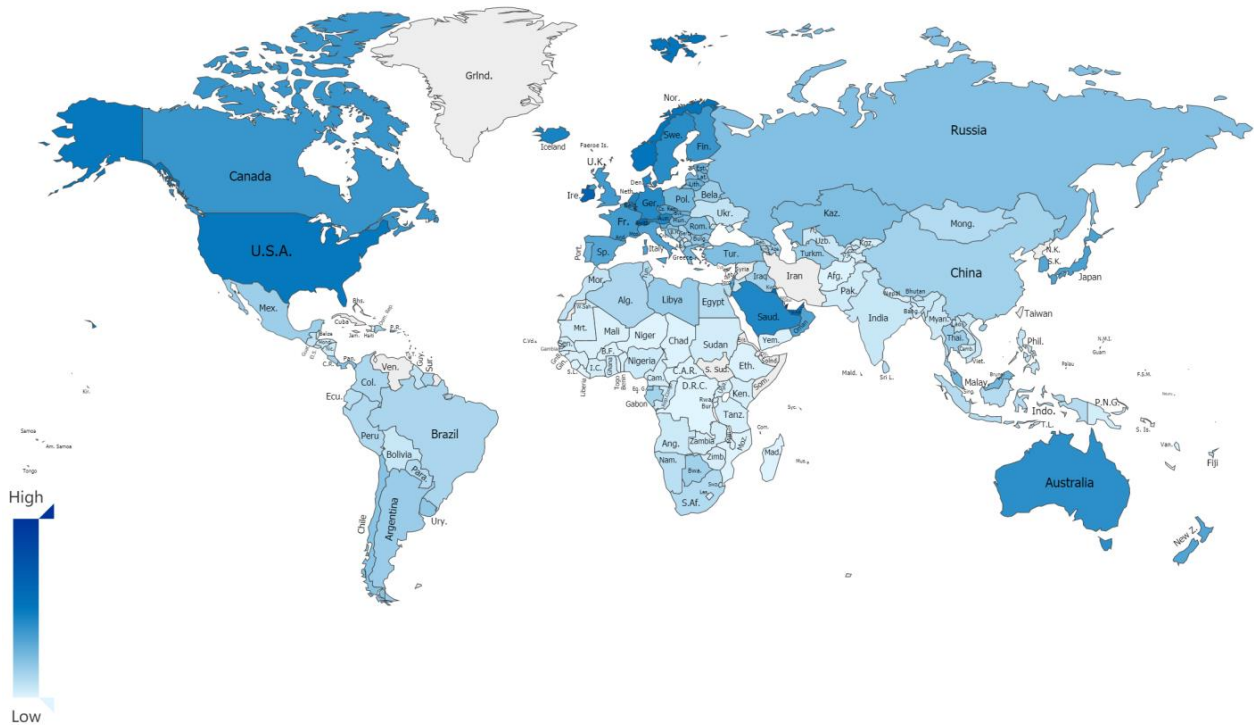


Figure 5: Educational health in different countries

Taking Singapore, Japan and India as examples, this paper analyzes and calculates the health degree of their higher education system. Based on the real data, we have investigated the enrollment rate of higher education, the number of published papers, teaching conditions, the financial support of the state for higher education, the ratio of male to female students and other indicators in the three countries. However, due to the great differences in the population of the three countries, we calculated the proportion of each index relative to the population of their own countries, and thus obtained a more objective comparison result. Finally, according to the weight of each index, we get the health scores of the three national education systems.

4.3. Problems & analysis

Through figure 5, we can find some facts. You may be surprised that Singapore, as a developed country, has such a high Gini index, but we must admit that there is a large gap between the rich and the poor in Singapore, which makes the educational resources in Singapore even more unbalanced. However, even so, the health of higher education in India still lags behind Japan and Singapore, as shown in Figure 6.

Target layer	system layer	index layer	Index score		
			Singapore	Japan	India
Health evaluation system of Higher Education A	Rate of enrollment B1		88.98	75.27	21.74
	Equity B2	Gender differences C1	85.59	83.07	61.45
		Gap between rich and poor C2	77.54	94.92	82.21
	Value of degree B3	School/Subject level C3	97.35	92.18	45.67
		Graduation rate C4	76.38	87.16	52.3
	Cost B4	Financial appropriation&efficiency C5	88.58	78.64	40.74
		Government loan C6	98.32	72.15	14.43
	Level of research B5	Academicians and eminent scholars C7	99.56	80.76	9.24
		Category normalized citation impact C8	77.32	96.51	72.63
	Quality of Education B6	Curriculum C9	89.8	92.15	52.78
		Faculty C10	74.57	90.21	85.34
	International exchange B7	International students C11	96.72	74.34	28.52
Recruit standard C12		82.98	85.27	41.74	
		total	79.173	84.456	46.659

Figure 6: Health scores of Singapore, Japan and India

The Higher Education system in India is complex, with relatively stagnant growth of public sector, private sector now accounts for 75 % of the total Higher Education institutions and 65% of the total enrolments in Indian Higher Education.

Sustainable development of the Higher Education system is the process of equipping students with knowledge, understanding and skills. Under these underlying principles, we searched some information and come to the following conclusions.

- Constraints from social environment, primary education and local policies

With a Gross Enrolment Ratio (GER) of 18.05%, India is still below the world average, which has a lot to do with the level of primary education in India, as well as the fairness of local policy and social environment issues, such as caste issues. For example, according to the 2001 Population Census, the population of scheduled castes and scheduled tribes in India accounted for 16.2% and 8.2% of the total population, respectively, while in terms of access to higher education, they accounted for 6.7% and 4.86% respectively, far from the proportion of the population.

- Lacks of Awareness

Most students want to obtain degree merely as a preparation for employment. At the same time, the graduation rate is low, which is caused by many reasons, but the negative ones take big parts. Firstly, it's about the attitude of the students themselves and the importance they attached to education. And their poor knowledge bases makes it difficult for them to meet the requirements of graduation. Of course, there are many families unable to afford the tuition and students are forced to drop out of school.

- Financial input is insufficient and the efficiency is too low

Financial expenditure and efficiency of education is also a big issue in higher education in India, where education expenditure accounts for only 4.3% of total expenditure, much lower than in developed countries. The financial efficiency of education is also low, which indicates that management system is backward and corruption cannot be ruled out.

- Absence of experts

India has a large number of overseas students, accounting for 30%. In western countries you can

see many Indians in important positions and many industries are monopolized by Indians. However, the fact is that there are few experts and eminent scholars in India, and most of them are indigenous, which shows that Indian higher education and policy is not attractive, open, ideological and limited.

5. Our proposal



Figure 7: About enrollment rate

- About enrollment rate

Based on the impact of India's traditional cultural factors, the quality of basic education, and social diversity, India's net enrollment rate, gross enrollment rate, and female enrollment rate are quite different from those of the other two countries compared, as shown in Figure 7.

1) Through consulting the data, we find that India has a reservation system to reserve higher education places for vulnerable caste groups. However, the general level of students enrolled in the name of retention system is not as good as other students, so this system reduces the academic standards and is not conducive to the improvement of the overall quality of the school. For this reason, we think that we should appropriately reduce the retention rate of the retention system, but considering the education level of the vulnerable caste groups, we still provide a bonus policy when they enter the University.

2) Arrange the students who have good performance in their study to coach the students who have poor performance, and issue honorary certificates for their helpful behavior, encourage enterprises to consider graduates with these honorary certificates when recruiting, fully mobilize the enthusiasm of supporting teaching, and form a virtuous circle.

3) The government should join in the expansion of enrollment: providing educational scholarships after the college entrance examination; starting the scholarship program for studying abroad at home; providing subsidies to vulnerable caste groups, especially girls, to subsidize their living expenses and extend their college education time to improve the graduation rate. Provide general education for all children in India, and everyone can go to a good university.

4) We should fully balance the differences in education levels among different states, adjust the difficulty of the examination, ensure fairness. Seriously deal with cheating candidates, and limit the preferential policies for their children and siblings when they enter school, thus safeguard the fairness of the examination as well as ensuring the quality of the students.

5) Appropriately reduce the difficulty of admission to famous schools and guide the diversity of enrollment While strictly controlling the entrance threshold of ordinary colleges and universities, so as to provide the possibility for children from disadvantaged families to enter famous schools, as shown in Figure 8.



Figure 8: About government loan

- About government loan

It is a major policy for the Indian government to provide student loans to outstanding young people in financial difficulties. In order to further improve the financial aid policy system, we put forward some financial means to support the reform of higher education system, and many parties should take practical actions.

1) The government can appropriately extend the grace period for repayment of student loans (such as 3-5 years), reduce the repayment pressure of students at school, so they can increase the investment in learning and scientific research, or extend the time range of student loans, starting from the primary school education of the students who need to be subsidized, until the students can earn income by participating in work (such as one year after graduation).

2) The interest rate of student loan should be reduced appropriately. The interest rate of newly signed student loan can be reduced by 10-30 basis points according to the loan prime rate, (LPR). And the loan within a certain amount (such as 400000 Rupees) should be free of third-party guarantee, so that students can boldly apply for loans and realize their dream of completing their studies.

3) The government can actively cooperate with the school, appropriately increase the amount of student loans for students with excellent academic performance thus form a good demonstration effect. Help students establish the concept of self-reliance and encourage students to study hard and make progress. It will forcefully promote the reform of quality education for college students.

4) The government can widely coordinate with the Bank of India, the United Bank of India and other institutions to help college students obtain more diversified and more preferential education loans. We can also appeal to social media and Indian charities (such as the wadhvani Foundation) to provide loans or subsidies to students in need, and reduce the burden of the government in this way, so that the government's student loan policy can be continued, as shown in Figure 9.

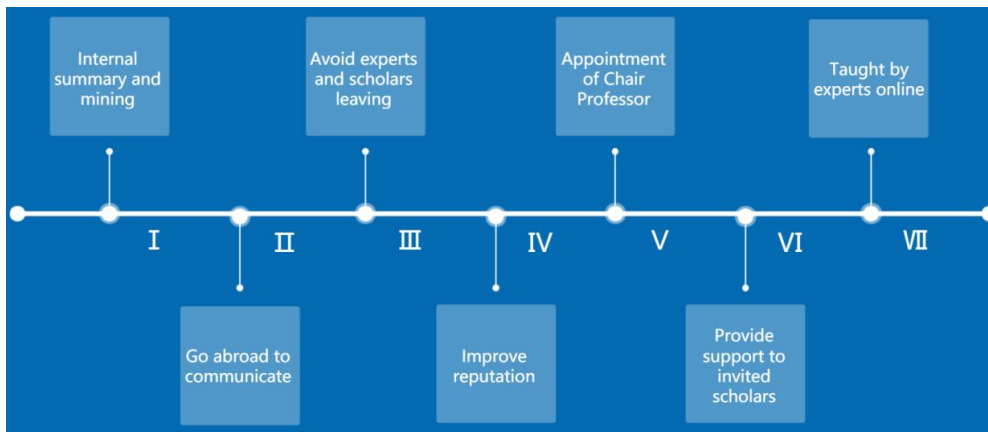


Figure 9: About academicians and eminent scholars

- About academicians and eminent scholars

No matter which country or university, academicians, experts and scholars are the most valuable assets in this industry. In order to increase the number of experts and scholars to improve India's scientific research level and improve India's higher education system, we should select and train internal talents from the middle level, and at the same time attract external academicians, experts and scholars.

1) Due to the long-term nature and uncertainty of talent cultivation, and the relatively backward environment of Indian higher education system at the present stage, the effect of talent cultivation may not be achieved in the short term. However, some measures can also be taken to tap and improve the potential senior talents. For example, a teaching or scientific research exchange summit will be held every natural science year to make achievements in teaching or scientific research in this academic year Outstanding achievements of teachers to summarize and commend

2) A certain amount of funds shall be allocated from the funds for education. It provides opportunities for excellent talents to communicate with top academicians, experts and scholars from all over the world, and provides certain exposure for these talents, so as to attract better master's and doctoral students.

3) Speed up the modernization of manufacturing industry and service to provide guarantee for the renewal of educational facilities in Colleges and universities. In order to attract talents, high-level talents should be given economic rewards, granted national titles, or provided their future generations with education guarantee mechanism.

4) Establish the reputation of the discipline or the whole university (for example, the Indian Institute of technology is known as the Pearl of the IT crown, which has transported a large number of IT talents to all over the world) to stimulate the investment sponsorship of Companies in relevant professional fields, so as to attract more talents.

5) Setting up the post of Chair Professor, implementing the appointment system of Chair Professor, providing enough salary and certain placement fee for Chair Professor; setting up a special committee to be responsible for the evaluation and selection of chair professor. Candidates must not only be internationally renowned scholars, their research fields must be in line with the University's key disciplines. His role is to lead the curriculum reform and textbook construction of the discipline. Leading the discipline and even the school into the first-class echelon.

6) To facilitate the introduction of high-level talents, provide them with relocation costs, reimbursement of air tickets and freight transportation costs.

7) Nations have had the opportunity to reflect on what is working and what could be even better. What has been made clear through this pandemic is the importance of disseminating knowledge across borders, companies, and all parts of society. Invite foreign well-known scholars to conduct

online exchange and teaching, which can invite more professionals to share experience and provide learning opportunities for more people in China. In the severe situation of the epidemic, this form is also safer and healthier.

6. Prediction model of policy effect

6.1. Establishment of the model

The ARIMA model can predict the future data from two information: the first one is autoregressive (AR), which is the data prediction at any time depending on the previous data, and the second one is the moving average (MA), which is the data prediction that depends on the previous errors.

The development of the ARIMA model needs analyzing step to define a suitable form of ARIMA (p, d, q), in which p, d and q are integer. The parameter p is for autoregressive. The parameter d is for the transformation from non-stationary to be a stationary time series. The parameter q is the moving average. The steps to develop the ARIMA model can be shown as in Fig.10. To model the ARIMA, we will be using the ARIMA(p,d,q) function of the MATLAB Econometrics Toolbox with the development details described as follows.

- 1) Prepare the data of the observed index and do the pre-processing.
- 2) Split the data into 2 groups. The first group is the initial ten year's data: 2006 to 2015. The second group is the validating data (the targeted policies is executed through timeline): 2006-2020.
- 3) Define suitable parameters of ARIMA (the parameters p, d and q) by using ARIMA(p,d,q) function of the MATLAB Econometrics Toolbox, as shown in Figure 10.

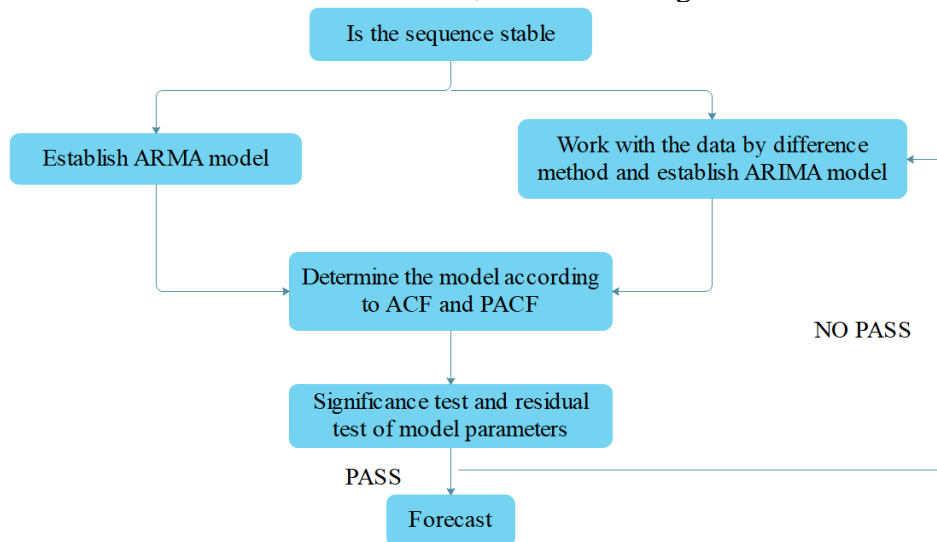


Figure 10: Steps to develop the ARIMA model

- 4) Generate ARIMA model by using “arima()” function.
- 5) Predict 10 observed values in the first group data set, 2016-2025; and 5 observed values in the second group data set, 2021-2025, by using “forecast()” function.
- 6) Measure the forecasting accuracy with RMSE and MAPE metrics that can be computed as in equations 10 and 11.

$$\text{RMSE} = \sqrt{\frac{1}{n} \sum_{t=1}^n (y_t - \hat{y}_t)^2} \quad (10)$$

$$MAPE = \frac{1}{n} \sum_{t=1}^n \left| 100\% \frac{y_t - \hat{y}_t}{y_t} \right| \quad (11)$$

Where y_t is the observed value at time t , \hat{y}_t is the predictive value at time t , n is the amount of the predicted time period.

6.2. Application of the model

According to the above details and India's index score, we selected the three indicators with the lowest scores for policy interventions, which are Rate of enrollment B1, Government loan C6, Academicians and eminent scholars C7. Then, we use Arima based forecasting model to forecast the first group (without intervention) and the second group (with policy intervention) for 10 years, and reflect the situation in the broken line statistical chart, as shown in Figure 11, Figure 12 and Figure 13.

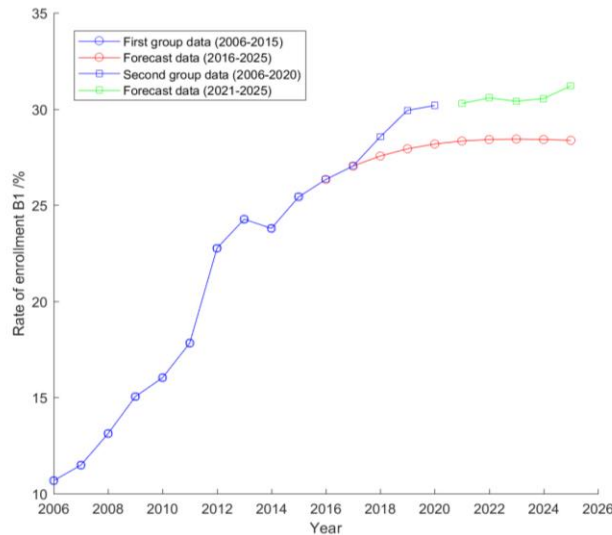


Figure 11: Forecast of enrollment rate

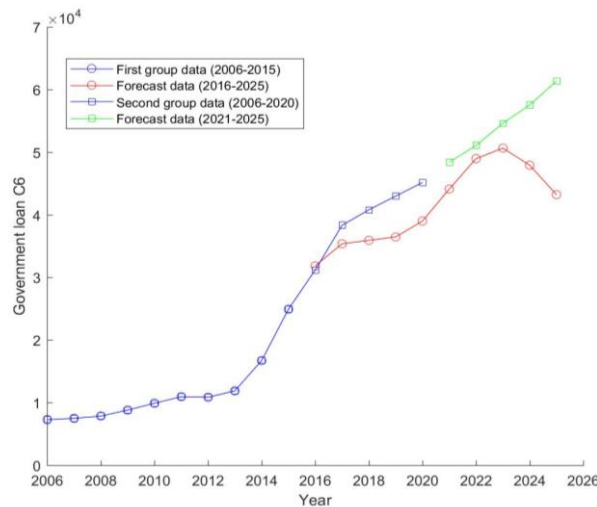


Figure 12: Forecast of government loan

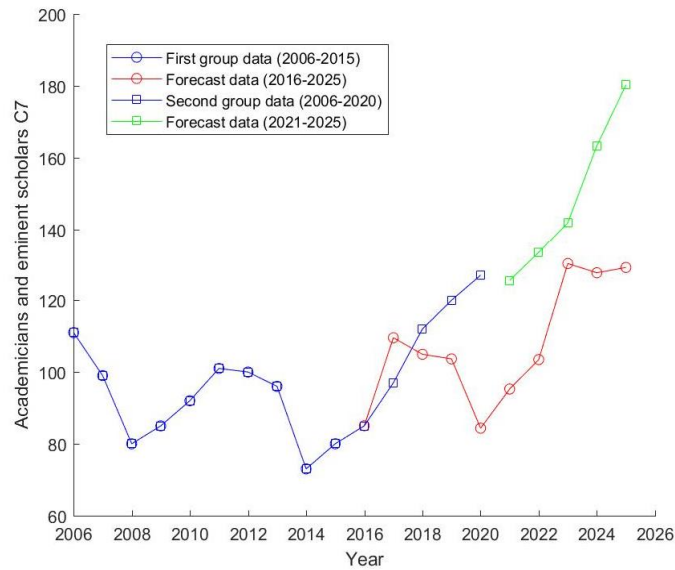


Figure 13: Forecast of academicians and eminent scholars

As can be seen from the broken line statistic chart of Rate of enrollment B1, the first group without intervention (red line) rose slowly and steadily, stabilized at about 28%, and even had a downward trend. After 5 years of policy intervention (blue box line), the next 5 years (green line) are above 30% and have an upward trend.

In the broken line statistic chart of Government loan C6, the first group (red line) is very unstable. Although it has been rising in the early stage, it has been declining obviously in the later stage. However, the second group keeps going up. It shows that the intervention effect is excellent.

Academicians and eminent scholars C7 is the lowest health score in India's higher education system. Due to its small base, the previous curve (blue circle) was steep, causing the first group (red line) to change erratically. Because of this, the curve of the second group (blue box and green line) changed significantly after the policy intervention, indicating that this is an urgent need for improvement and that the policy intervention had an immediate effect.

After completing all the predictions for both groups, we used the Health Evaluation System of Higher Education again to score the two groups of data together with the previous scores, as shown in the table.

The score of B1 after the intervention (the second group) was 1.04 points higher than before the intervention (the first group) and 7.31 points higher than before. The effect of C6 was more significant, 4.58 higher in the second group than in the first; Based on an overly small base, the second group also saw a significant improvement in their C7 scores, which was 1.08 points.

Without the guidance of our policy, India's higher education system would have scored 51.752 after 10 years of development, an increase of about 10.9%. But with the effective intervention of the policy and timeline plan, the score is predicted to rise to 52.282 points, an increase of about 12.1%. This fully demonstrates the effectiveness of our policy towards the three indicators B1, C6 and C7. The result is also reflected in the radar chart intuitively.

7. Sensitivity analysis

The assessment tools increasingly used in Higher Education to implement continuous improvement policies for healthy and sustainable higher education is composite indicators, which are a mathematical aggregation of a selected set of suitably weighted indicators. Composite indicator building should be accompanied by sensitivity analysis to ensure good practice.

Sensitivity analysis helps to improve the understanding and, ultimately, the soundness of the composite, as shown in Figure 14 and Figure 15.

Target layer	system layer	index layer	Index Score		Previous score	
			First Group	Second Group		
Health evaluation system of Higher Education A	Rate of enrollment B1		28.01	29.05	21.74	
	Equity B2	Gender differences C1		72.73	72.73	61.45
		Gap between rich and poor C2		90.21	90.21	82.21
	Value of degree B3	School/Subject level C3		62.45	62.45	45.67
		Graduation rate C4		71.54	71.54	52.3
	Cost B4	Financial appropriation&efficiency C5		49.99	49.99	40.74
		Government loan C6		31.76	36.34	14.43
		Academicians and eminent scholars C7		10.12	11.2	9.24
	Level of research B5	Category normalized citation impact C8		74.67	74.67	72.63
		Curriculum C9		50.64	50.64	52.78
	Quality of Education B6	Faculty C10		89.32	89.32	85.34
		International students C11		26.86	26.86	28.52
International exchange B7	Recruit standard C12		43.58	43.58	41.74	
		total	51.752	52.282	46.659	

Figure 14: The effect of the intervention 1

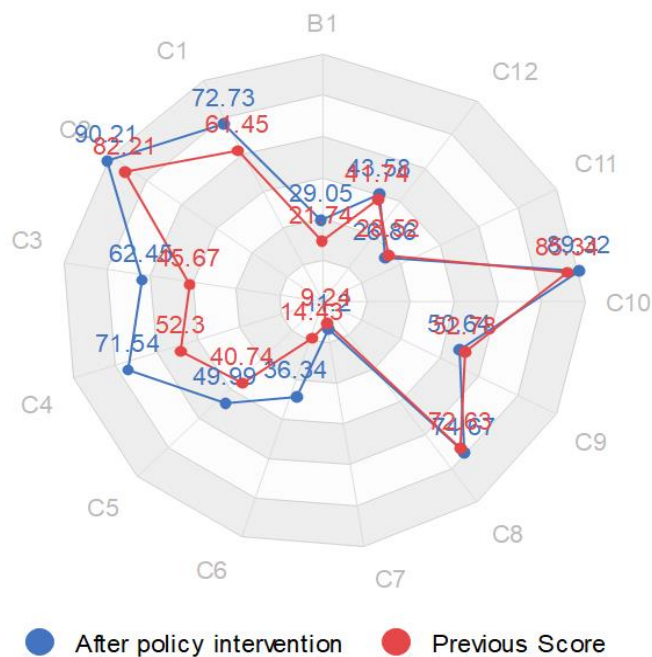


Figure 15: The effect of the intervention 2

In our work, we did the sensitivity analysis as follows:

1) For the measurement with the health of higher education of India, we ignore the especially important indicators (B1, C6 and C7) and recalculate the weighted score and the final score. The

Final score increased by 30%. Therefore, it is an effective choice to specify policies based on these three indicators.

For the measurement with the health of higher education of India, we ignore the random three indicators (C1, C9 and C12) and recalculate the weighted score and the final score. The final score increased by 9.7%. It means that less indicators will take the score more unreliable. Hence, we propose sensitivity analysis as a necessary tool for re-adjusting weights in order to achieve the desired level of importance for each component indicator, as shown in Figure 16.

	Previous score	Sensitivity Analysis	New weight1	Sensitivity Analysis	New weight2
Rate of enrollment <i>B1</i>	21.74	---	---	21.74	0.1886
Gender differences <i>C1</i>	61.45	61.45	0.05515407	---	---
Gap between rich and poor <i>C2</i>	82.21	82.21	0.04970158	82.21	0.0851
School/Subject level <i>C3</i>	45.67	45.67	0.02945905	45.67	0.02398776
Graduation rate <i>C4</i>	52.3	52.3	0.03292776	52.3	0.02681224
Financial appropriation&efficiency <i>C5</i>	40.74	40.74	0.14953533	40.74	0.06886113
Government loan <i>C6</i>	14.43	---	---	14.43	0.05303869
Academicians and eminent scholars <i>C7</i>	9.24	---	---	9.24	0.08380725
Category normalized citation impact <i>C8</i>	72.63	72.63	0.24236724	72.63	0.11269275
Curriculum <i>C9</i>	52.78	52.78	0.13854861	---	---
Faculty <i>C10</i>	85.34	85.34	0.17237735	85.34	0.2518
International students <i>C11</i>	28.52	28.52	0.07159088	28.52	0.1053
Recruit standard <i>C12</i>	41.74	41.74	0.05832513	---	---
total	46.659	60.679	1	51.186	1

Figure 16: Sensitivity analysis

8. Strengths & weaknesses

Improving assessment of the health of any nation's system of higher education is crucial. Beyond input-leads-to-output thinking, more data and analysis are needed on what happens between inputs and outputs in the educational process, with a particular focus on the learner and what they are thinking and doing. What are learners' experiences? What are they doing? Will it help and, if so, how can it be taken forward? Which pedagogies can amplify and help shape this process? What part should curricula play? These questions are crucial to influence the effectiveness of our policies.

8.1. Strengths

After establishing the higher education health evaluation system, we screened out 13 indicators to ensure the objectivity of the evaluation. Further, in order to ensure the stability of the model, we use the complex method of the entropy weight method and AHP model to weight each index. Then we use the established model to evaluate the evaluation object, so as to give effective transfer strategies, we approached the problem from different perspectives, thus giving a comprehensive description of our model from other perspectives.

In the analysis of policy effectiveness, we use ARIMA based prediction models for grouping comparison, taking into account the development of the evaluation objects themselves, rather than limiting their level to existing scores, thus making the model more reliable and more widely applicable.

8.2. Weaknesses

There are still several weaknesses to be considered. One of the weaknesses is that the model cannot

consider variables that do not have definite/accurate data, or only have qualitative measures. The model must produce a weight table of the observed index, and hence scores which can be used to determine the health of the higher education system. This means that many important factors have had to be disregarded in the building of this model.

Since we assume that there is no correlation between indicators, indirect influence and correlation under many real circumstances cannot be taken into account, which reduces the persuasiveness of our model.

9. Conclusion

Although the results are not completely objective due to the model and data reasons, we have achieved the expected results on the whole. In the analysis of the results, we found some problems in the Indian education system, and put forward some suggestions on the enrollment rate, government loans and how to attract high-end talents, which have been proved to be effective after prediction by the ARIMA model.

However, during the implementation of the plan, we think it will cause the following negative effects.

As for the measure of reducing the number of places reserved for the disadvantaged castes in Colleges and universities, although the corresponding bonus policy is provided for the disadvantaged castes, the opportunity for them to receive higher education is still reduced on the whole. We think that in the process of implementation, it may aggravate the unfairness of education, and even intensify the class contradictions.

The large amount of student loans may make students with weak self-control ability unable to devote themselves to reasonable study and life entertainment, which not only does not help students, but also may induce students to commit crimes because they are unable to repay the loan, disillusioning the original intention of government student loans.

On the other hand, the coronavirus outbreak has caused severe damage to the higher education system. Most universities have cancelled offline teaching and switched to online teaching. Not only that, the coronavirus affects almost every aspect of everyone's life. These hidden dangers affect the future of the higher education system from fiscal imbalances in the form of unpredictable costs and potential revenue reductions. In fact, we do face many challenges and policy issues, such as campus closures and student learning interruptions. At the same time, this unprecedented shift to online teaching has also caused us to worry about the quality of distance education. Especially for students who are prone to academic difficulties, the continuation of the coronavirus epidemic will hinder their progress in completing their studies or obtaining certificates. In addition, funding challenges faced by universities will follow. Unexpected expenses, such as refunds of student accommodation fees and the maintenance of computer systems required for online teaching, will surge. Some uncertain budgets will force the government to reduce funding for higher education institutions. College students who have studied at home for a long time may easily lead to disharmony between family relationships, and increase the pressure of college students. The popular environment has brought a lot of inconvenience to the exchanges and visits of academicians, experts and scholars from various countries. In short, there is still a long way to go to improve a country's higher education system.

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