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# *Research on Evaluation Algorithm of the Higher Education System Based on Neural Network*

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***Keywords:*** Higher education system, Neural network, Backpropagation algorithm, Legatum Education Prosperity Index

***Abstract:*** The evaluation of a country's higher education system is an academic subject of great research value, which helps to explore the defects of the national higher education system, so as to promote the healthy development of the higher education system. In this paper, we collect health data on higher education in many countries, including gross enrollment rate, percentage of higher education expenditure in government education, ratio of unemployed people to total unemployment at higher education level, graduation rate, entry employment rate, teacher-student ratio, Legatum Prosperity Index (education). After that, we take the top six indicators of various countries as input and Legatum Education Prosperity Index as output and establish a neural network comprehensive evaluation model to measure the health level of higher education in various countries. Through the empirical analysis of the model applied to the actual data of six countries, it is found that the health level of higher education in El Salvador is relatively low.

## 1. Introduction

There are significant differences in the development level of higher education among countries all over the world. Although every country may have national standards to measure the level of higher education, in this era of globalization, the establishment of global standards to measure the healthy and sustainable development of higher education will contribute to the healthy development of higher education in all countries.

In this paper, we establish a two-layer neural network model to evaluate the health of the higher education system and use Internet data to train the model parameters based on the backpropagation algorithm.

## 2. Data Sources

The experimental data used in this paper are from databases on the Internet, including World Bank [1], Our World in Data [2], EPS data platform [3], and so on. In some countries, especially those with weak overall national strength, the lack of data is serious. Although some countries lack data, we include as many countries as possible, such as missing countries, and we replace them with data from countries in the same region.

## 3. Comprehensive Evaluation Model based on Neural Network

### 3.1 Terms, Definitions and Symbols in Model

The terms, definitions, and symbols used in the model are shown in Table 1.Because the Legatum Prosperity Index (education) is a good indicator of a country's overall education level, it was used as a current comprehensive evaluation value to train the neural network.

*Table 1: Terms and Definitions of X and Y (X=Input, Y=Output)*

| Terms | Definitions |
|---|---|
| $X_1$: Gross enrollment rate(%) | Refers to a specific academic year, the number of students in a certain level of education occupies the proportion of the corresponding school-age population's total number, marking the relative scale of education and educational opportunities, which is a critical indicator measure the level of education development. |
| $X_2$: Expenditure of higher education of government (%) | The proportion of government spending on higher education in GDP |
| $X_3$: Graduation rate(%) | The proportion of the total number of new students in higher education who graduated within the years specified by the national or local schooling system |
| $X_4$: Rate of inbound study | For international students in higher education: The number of students on campus accounts for the total enrollment proportion. |
| $X_5$: Student-faculty ratios | The ratio between the number of teachers and the number of students in higher education |
| $X_6$: Ratio of unemployed persons at higher education level to total unemployed persons | The ratio of unemployed persons at higher education level to total unemployed persons |
| Y: Legatum Prosperity Index (Education) | The Legatum Institute's annual Global Education Prosperity Index |

### 3.2 Neural Network Model

This study only uses the two-layer BP neural network model structure [4]. This paper contains a total of 49 sets of data, of which 43 sets of data are divided into training sets, and 6 groups are used as test sets to evaluate the prediction results of the model. At the same time, we realize the application of the model.

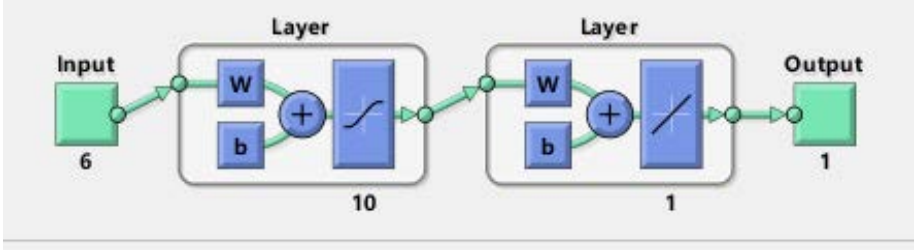


*Figure 1: Neural Network Structure Diagram*

The super parameters we set in this paper are as follows:
Number of hidden layers neurons=10,

Network training parameters: Set display interval =50; Set learning rate =0.05; Set the momentum item to 0.25; Set training times =5000; Set training target value = 1e-5;

### 3.3 Model Prediction Result

The prediction results of the proposed model on the test set are shown in Table 2.

*Table 2: Prediction Results on the Test Set*

| | Norway | Poland | Portugal | El Salvador | Slovenia | China |
|---|---|---|---|---|---|---|
| **Predictive value (evaluation value)** | 83.62403 | 74.21561 | 71.5198 | 61.59098 | 81.45052 | 69.55963 |
| **Real value** | 83.35 | 73.75 | 71.73 | 60.82 | 80.38 | 79.55 |

In addition, in the experiment in this paper, we choose the deviation rate as the evaluation index(As Table3 see). It is defined as follows:

$$if \ \text{real value} < 0.1 : \text{Deviation rate} = \frac{|\text{real value - predictive value}|}{0.1} \times 100\%$$

$$if \ \text{real value} \geq 0.1 : \text{Deviation rate} = \frac{|\text{real value- predictive value}|}{|\text{real value}|} \times 100\%$$

*Table 3: Deviation Rate of the Above Six Sets of Data*

| Norway | Poland | Portugal | El Salvador | Slovenia | China |
|---|---|---|---|---|---|
| 0.003287757 | 0.006313292 | 0.002930374 | 0.01267644 | 0.013318289 | 0.125586047 |

Average deviation rate =0.027352

The deviation rate is within the acceptable range, and the model established by the neural network is accepted.

### 3.4 Analysis of the Result

Under the evaluation system established in this paper, the higher the comprehensive evaluation value, the better the situation of higher education. On the contrary, the lower the comprehensive evaluation value, the worse the situation of higher education.

From the comprehensive evaluation value of higher education in six countries obtained by neural network simulation, it can be found that El Salvador has a relatively low score, which indicates that there may be some problems in its higher education. (El Salvador is a coastal country located in the northern part of Central America. It is also the most densely populated country in Central America. El Salvador borders the Pacific Ocean. It covers an area of 20,720 square km and is divided into 14 provinces. The country has a total population of 6.378 million (2017). ) According to the World Bank, in 2017, El Salvador has a population of 6,377,853 and a per capita national income of US $3,889.3 per year, much lower than Latin America's national income of US $9,274.8 per year[5]. In 2012, for example, China's per capita national income was $8,690, while El Salvador's was $3,560 [6].

The reason is that El Salvador is a relatively poor country in Central America.

Its domestic industry is mainly concentrated in traditional agriculture and mining.

El Salvador is a typical economy of primary agricultural products and resources, and the high

poverty rate seriously restricts its economic development.

Based on this background, the government's primary task is to eradicate poverty, not to revitalize higher education, which limits the development of higher education.

The situation in El Salvador will be analyzed in detail at a later stage.

## 4. Conclusion

The main work we have done in this paper is as follows:

(1) We search the Internet for higher education data from different countries to reflect the health and sustainability of higher education, such as higher education investment in different countries and the ratio of teachers to higher education students.

(2) We use the neural network comprehensive evaluation method to quantify the index data and establish the evaluation model of higher education.

(3) The model is applied to the evaluation of higher education levels in specific countries.

If a country has a low score, it still has much room for improvement.

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