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Research Article

Quality Evaluation Method of College Graduates' Innovation and Entrepreneurship Education Based on the Principle of Brain Neurology*

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Abstract

Under the historical background of the national development strategy of mass entrepreneurship and innovation, the education of innovation and entrepreneurship has gradually become an important indicator to evaluate the quality of talent cultivation in colleges and universities. To expand the evaluation methods of innovation and entrepreneurship education in colleges and universities, this paper adopts literature analysis, case analysis, BP neural network method and other research methods. Focusing on the research of quality evaluation methods of college graduates' innovation and entrepreneurship education, based on a brief introduction of innovation and entrepreneurship education, teaching quality evaluation and artificial neural network, this paper combines expert questionnaires and interview results, and establishes a three-level college graduate innovation and entrepreneurship education evaluation index system. Based on BP neural network, an evaluation model of innovation and entrepreneurship education based on BP neural network has been established, and the tourism major of S University is selected as an example to apply the innovation and entrepreneurship education evaluation model constructed in this paper. By integrating qualitative analysis with quantitative analysis, the quality of innovation and entrepreneurship education is evaluated, and corresponding improvement suggestions are put forward for the evaluation results.

Keywords

Innovation and Entrepreneurship Education • Quality Evaluation • BP Neural Network

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Mass entrepreneurship and innovation are important ways to promote social and economic development. With the rapid development of economy and society, world competition is becoming increasingly fierce, and the demand for innovative and entrepreneurial talents is increasing gradually. At present, the development of innovation and entrepreneurship has not reached the expected level (Barton *et al*., 2007). Colleges and universities, as the base for talent cultivation, are shouldering the important mission of meeting social needs and cultivating qualified talents, and they need to improve the quality of innovation and entrepreneurship education in the process of education and teaching (Xiao *et al*., 2009).

As early as in 1970, the University of Purdue had held an entrepreneurial conference meeting. Subsequently, many colleges and universities in Canada and the United States had held annual conferences and seminars on entrepreneurship education (Mcclure, 2016). In 1990s, UNESCO proposed that entrepreneurship is an important skill that should be granted to the graduates by colleges and universities. Compared with foreign countries, China's innovation and entrepreneurship education is still in its infancy, existing researches mainly focus on the introduction of foreign entrepreneurship education theories, the connotation and purpose of entrepreneurship education, etc., however, for now, there is no scientific or systematic quality evaluation method for innovation and entrepreneurship education.

Artificial neural network (Harkema and Scshou, 2008) is an algorithmic mathematical model that simulates the synaptic connection structure of the brain and consists of a large number of processing units (neurons) for distributed performance information processing. It has self-learning, self-organization, and self-adaptation abilities. BP neural network is a multi-layer feedforward neural network. At present, it has formed a relatively mature mode in the quality evaluation of innovation and entrepreneurship education.

Based on the above analysis, this paper takes the quality evaluation method of college graduates' innovation and entrepreneurship education as the research goal (Alvarezguerra *et al*., 2008). Based on a brief introduction of relevant theories, combined with the results of expert questionnaires and interviews, the quality evaluation system of college graduates' innovation and entrepreneurship education is constructed (Oehler *et al*., 2015). After introducing BP neural network, an evaluation model of innovation and entrepreneurship education based on BP neural network is established. Taking the tourism major of S University as an example, the neural network function is calculated by Matlab software, then the established evaluation model is applied to analyze the current situation of the teaching quality of innovation and entrepreneurship education, and the analysis results are taken as a basis to propose corresponding improvement suggestions.

Relevant Theoretical Basis

Innovation and entrepreneurship education

Innovation education is an educational philosophy that insists on “innovation orientation”. Unlike the traditional “passive-receiving” education, innovation education focuses on the cultivation of students' practical ability and secondary discovery ability.

Entrepreneurship education has a broad sense meaning and a narrow sense meaning. The narrow sense meaning of entrepreneurship education is to enable learners to start their own businesses. In a broad sense, entrepreneurship education pays more attention to the spirit and skills, and it refers to cultivate talents to have the pioneering spirit.

Innovation education is the foundation of entrepreneurship education. The goal of both is to cultivate people with innovative spirit and practical ability. Therefore, innovation and entrepreneurship education is a kind of practical education to cultivate students' awareness, ability and spirit of innovation and entrepreneurship.

Teaching quality evaluation

There is no scientific management without scientific evaluation. The evaluation of teaching quality is an intermediate link in the rational allocation and design of the talent cultivation mode, and it has a decisive role in it. The evaluation of teaching quality is the value judgment of whether the educational achievements are in line with the educational purpose (Byrne & Flood, 2003).

The evaluation values of education can be divided into three stages: with educational achievements as the main evaluation object, “Taylor evaluation mode” as the leading factor, and focusing on education itself, educational process, and seeking diversified evaluation methods (Denekens, 2007). The theories of education evaluation have experienced three stages: the behavioral goal mode focusing on teaching outcomes, the idealized mode for seeking improvement, and the diversified developmental teaching evaluation mode.

Artificial neural network

Artificial neural network (Harkema and Scshou, 2008) is an algorithmic mathematical model that simulates the synaptic connection structure of the brain and consists of a large number of processing units (neurons) for distributed performance information processing, its structure is shown in Figure 1. It has high fault tolerance, strong self-adaptability and good nonlinear processing capability, which is widely used in various evaluation mechanisms (Bissola *et al*., 2017).

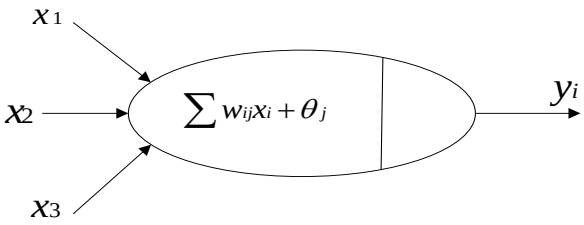

Figure 1. General description of neurons

BP neural network is a multi-layer feedforward network trained by error back propagation algorithm (Iezzi, 2005). Figure 2 shows the BP neural network learning flow chart. It has powerful nonlinear mapping ability, it

can realize autonomous modelling, the output is accurate, and it can solve the problem of quality evaluation of innovation and entrepreneurship education in colleges and universities.

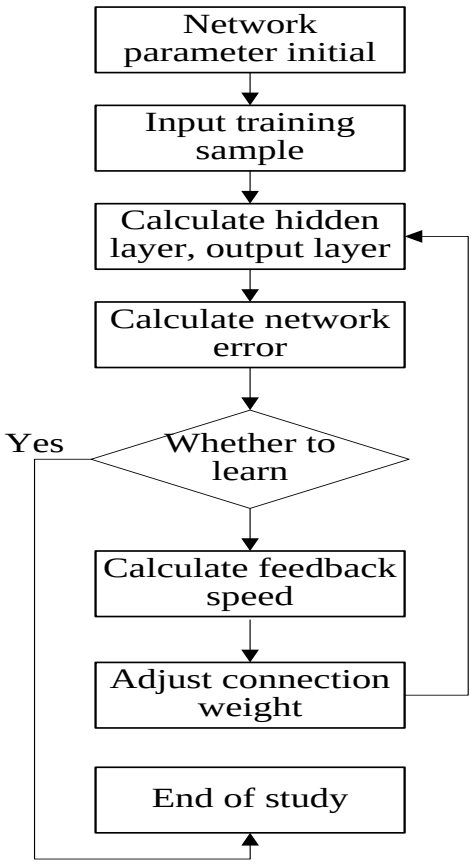

Figure 2. Neural network learning flow chart

Quality evaluation of college graduates' innovation and entrepreneurship education based on BP neural network

Construction of quality evaluation system

Innovation entrepreneurship education is a highly complex work. It is influenced by the individual factors such as the education mode and family situation of the students, the external factors such as the government, the enterprises and the social environment, and the internal factors such as the quality of the teachers and the teaching links (Mustar, 2009). Therefore, it is impossible to objectively and comprehensively evaluate it from one single dimension. Through interviews with education evaluation experts, and referring to the evaluation

index system of teaching work in ordinary colleges and universities, this paper summarizes the dimensions of teaching quality evaluation of college graduates' innovation and entrepreneurship education as shown in Figure 3.

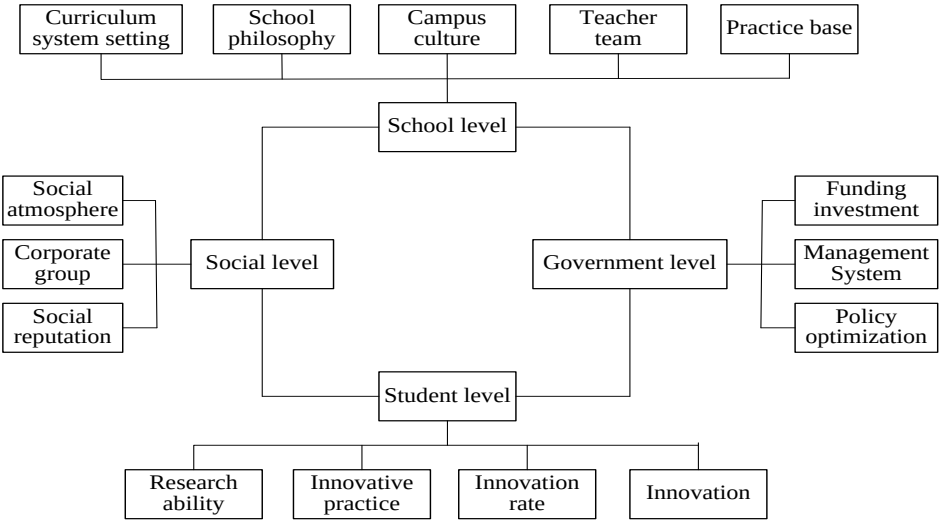

Figure 3. The dimension of teaching quality evaluation of innovation and entrepreneurship education

Table 1 shows the college graduates' innovation and entrepreneurship education quality evaluation system which contains 4 level-1 indicators, 6 level-2 indicators and 12 level-3 indicators after screened by the expert investigation method and the dimensions of college graduates' innovation and entrepreneurship education quality evaluation.

Table 1
The Quality Evaluation System of Innovation and Entrepreneurship Education

First indicator	Secondary indicators	Three-level indicator
College links	Innovation and entrepreneurial environment	National policy implementation x_1
		Entrepreneurship competitions x_2
		Number of school-enterprise cooperation projects x_3
Teaching session	Course design teaching method	Ratio of practical courses to theoretical courses x_4
		Core curriculum ratio x_5
		Number of open courses for entrepreneurs and entrepreneurs x_6
Teachers	Teacher background	Practice survey, case teaching ratio x_7
		Proportion of entrepreneurial experience teachers x_8
	Innovation and entrepreneurship education	Number of papers cited x_9
		Innovative entrepreneurship education case study ability x_{10}
Student evaluation	Student background	Proportion of students who have participated in entrepreneurship courses x_{11}
	Student performance	Student innovation rate increase ratex_{12}

Calculation process of quality evaluation of college graduates' innovation and entrepreneurship education—Taking the tourism major of S University as an example

Determination of node number. (1) Input layer nodes: determined by the number of factors affecting the evaluation results. Table 1 shows there are 12 level-3 indicators in the factors affecting the quality of innovation and entrepreneurship education, therefore, the node number in the input layer is 12. (2) Hidden layer nodes: the number of hidden layer nodes determines the fault tolerance and extensiveness of BP neural networks, its number is generally determined by formula (1). (3) Output layer node: namely the evaluation result, it's the score of the quality of college innovation and entrepreneurship education, so it is 1.

$$q = \sqrt{n+m} + a \tag{1}$$

Determination of neuron number. (1) Number of neurons in the hidden layer, If the number is too small, the fault tolerance is poor; if it's too large, it reduces the convergence speed of the neural network and increases the error. Usually, it needs continuous training to find the optimal number of hidden layer neurons in the BP neural network. In this paper, the trial-and-error method is applied (the results are shown in Table 2), and the number of neurons in the hidden layer is finally determined to be 8. (2) Learning rate η and dynamic factor a, If η is too large, unstable conditions will occur during the operation; if it's too small, the convergence speed may be prolonged. The learning rate is usually determined according to experience and learning results. This paper selects η=0.04 by comparing the learning rate training results.

Table 2
Convergence Contrast

Hidden layer unit	4	5	6	7	8
Number of training	11	16	7	11	6
Error	9.63061	4.00230	3.88315	2.25445	2.0123

Data initialization processing. This paper uses the maximum and minimum method to normalize input values so that the input values and the output values are between [0-1], the transformation formula is as follows:

$$X = \frac{Xi - Xmin}{X\,max - Xmin} \tag{2}$$

Table 3
Output Value Level Division

Grade standard	Neural network output value
excellent	0.90-1.00
good	0.80-0.89
moderate	0.70-0.79
Pass	0.60-0.69
failed	below 0.59

Table 3 shows the classification based on the output value of the neural network, which is divided into five levels: excellent, good, medium, pass, and fail. Table 4 shows the neural network output values after normalization.

Table 4
Processing data values

Index	C1	C2	C3	C4	C5	C6	C7
x_1	0.1362	0.2478	0.1567	0.0660	0.0355	0.1478	0.0506
x_2	0.2346	0.0789	0.0567	0.1458	0.2790	0.0434	0.1023
x_3	0.0657	0.1500	0.2002	0.0646	0.2158	0.1734	0.1159
x_4	0.1736	0.1419	0.0466	0.1269	0.0628	0.1736	0.2689
x_5	0.1869	0.1708	0.2956	0.0305	0.1082	0.0454	0.1559
x_6	0.0875	0.0439	0.1549	0.2878	0.1103	0.0879	0.2214
x_7	0.2104	0.1308	0.0516	0.1833	0.2359	0.0778	0.1044
x_8	0.1403	0.0609	0.3324	0.0869	0.0342	0.1745	0.1569
x_9	0.0908	0.0718	0.1264	0.2355	0.1809	0.1446	0.1466
x_{10}	0.3146	0.2122	0.0819	0.0319	0.1139	0.1804	0.0647
x_{11}	0.0607	0.0749	0.1658	0.1355	0.0749	0.1969	0.2868
x_{12}	0.1952	0.1756	0.1558	0.2538	0.0775	0.0384	0.0979

Experiment process. In this paper, the neural network toolbox of Matlab7.0 software is used for modeling. The neural network model is established for the above normalized data, the numerical values and precision of each parameter are determined, and the neural network training and simulation calculation are performed (Ritchings *et al*., 2002). Figure 4 shows the input nntool neural network main interface, Figure 5 shows the input data interface. The main calculation steps of the Matlab neural network toolbox are: first, use the init function to complete the setting of weights and initial values, and then create a network prediction model for network training and network simulation. Figure 6 shows the output result interface (Peel, 1998). Table 5 shows the output results of each index; the obtained comprehensive network output value is 0.7262. According to the classification of the neural network output values in Table 3, it can be known that the S University's innovation and entrepreneurship education is in a medium level.

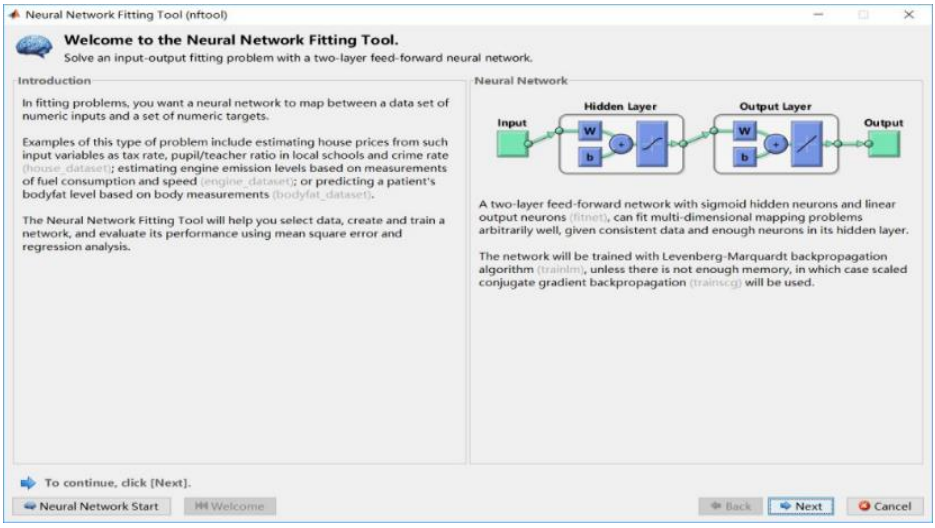

Figure 4. Enter the main interface of nntool neural network

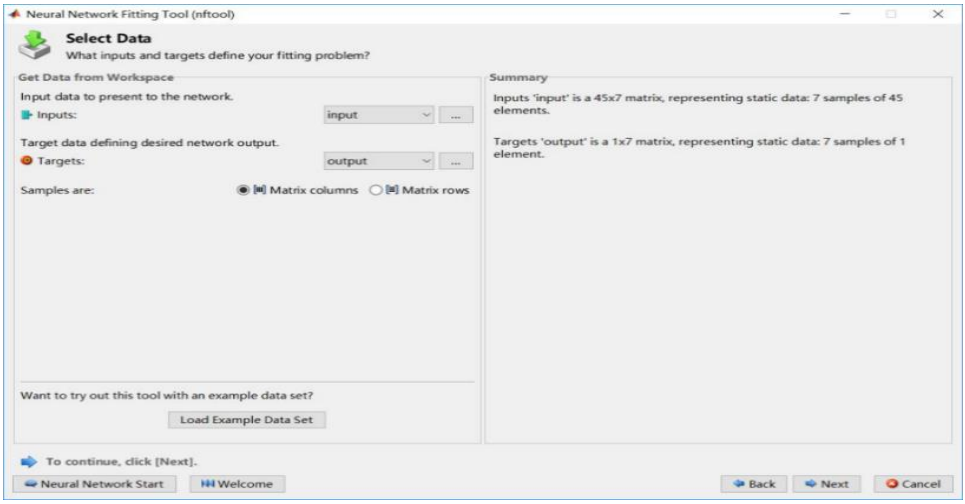

Figure 5. Input data interface

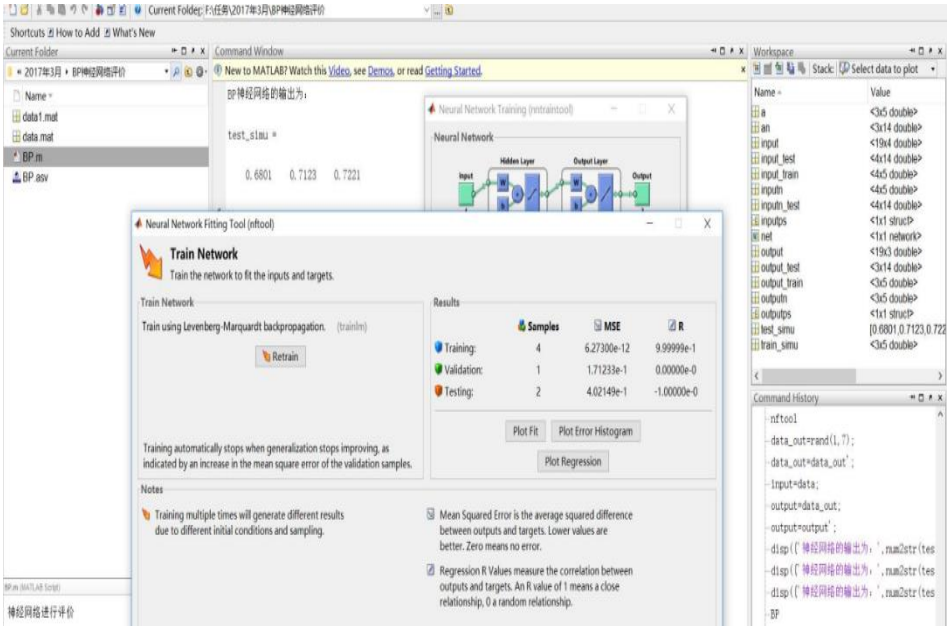

Figure 6. Output result

Table 5
Output Results of Various Indicators

Index	Result	Index	Result	Index	Result	Index	Result	Index	Result	Index	Result
x_1	0.60	x_2	0.70	x_3	0.95	x_4	0.48	x_5	0.50	x_6	0.80
Index	Result	Index	Result	Index	Result	Index	Result	Index	Result	Index	Result
x_7	0.73	x_8	0.59	x_9	0.80	x_{10}	0.72	x_{11}	0.86	x_{12}	0.90

Analysis of evaluation results

Through the result analysis of the evaluation indicators, we can see that S University's academic achievements in innovation and entrepreneurship education are significant, and a system of extracurricular activities has been initially formed. Basically, the school takes both the innovative and entrepreneurial knowledge and the professional knowledge into account, but it still has the following shortcomings:

The education concept of innovation and entrepreneurship is missing. It can be seen from the indicators x2=0.70, x6=0.80 that the acceptance and recognition of the concept of innovation and entrepreneurship education in colleges and universities is not deep enough. The main purpose of carrying out innovation and entrepreneurship education is to solve the problem of college students' employment, and has not established a good entrepreneurial atmosphere (Mok, 2015).

Insufficient policy support enforcement. The evaluation indicator of national policy implementation level is x_1=0.60, indicating that although the state has introduced many relevant policies to encourage and support colleges and universities to carry out innovation and entrepreneurship education, the policies have not been well-implemented, and the colleges and universities haven't formulated detailed policies or systems to support college students' entrepreneurship, and the relevant financial support is also very limited.

Insufficient teacher resources for innovation and entrepreneurship education. As transmitters of knowledge in innovation and entrepreneurship education, teachers should have rich practical experiences while possessing solid professional knowledge, and adopt flexible teaching methods suitable for innovation and entrepreneurship education, so that they can give effective guidance to students. However, from the teacher-related indicators (x_8=0.59, x_{10}=0.72), it can be seen that full-time teachers lack entrepreneurial and business management experiences, while part-time teachers lack teaching experience, so the quality of innovation entrepreneurship classroom teaching needs to be further improved.

Improvement suggestions for the innovation and entrepreneurship education of college graduates

In view of the problems existing in the innovation and entrepreneurship education of college graduates, this paper puts forward the following improvement suggestions:

Improve the guarantee system of innovation and entrepreneurship education in colleges and universities. The implementation of innovation and entrepreneurship education in colleges and universities is inseparable from the support of various administrative departments. Therefore, the government and other relevant departments should give organizational guarantee to the colleges and universities, providing preferential policies for innovation and entrepreneurship education of colleges and universities when formulating relevant policies, and support them with relevant fund, they should also provide communication channels between experts and entrepreneurs. At the same time, graduates' innovation and entrepreneurship are also inseparable from the support of relevant business groups and families.

Form a good entrepreneurial atmosphere for college students. A good innovative and entrepreneurial information platform can provide relevant resources, policies, projects, and other services for students'

innovation and entrepreneurship. The rules of innovation and entrepreneurship law are the legal guarantee for college students to start their own businesses. Therefore, establishing a good campus and social entrepreneurial atmosphere is a positive driving force for promoting college students' innovation and entrepreneurship.

Establish a strategic vision of innovation and entrepreneurship education. Action is guidance based on concept. Therefore, besides previous emphasis on the cultivation of applied and research-oriented talents, colleges and universities should upgrade the teaching concept, and take the cultivation of innovative and entrepreneurial talents with creativity and practical ability as the focus of the work; also, they need to comprehensively reform the curriculum system, teaching objectives, teaching methods, and teaching design, and firmly establish the concept of advanced innovation and entrepreneurship education.

Conclusion

After sorting out the related references of innovation and entrepreneurship education, teaching quality evaluation and artificial neural network at home and abroad, this paper takes the problem of quality evaluation method of college graduates' innovation and entrepreneurship education that is urgently needed to be solve in China's education field as the research goal, and obtains following conclusions after research:

With reference to the evaluation index system of teaching work in colleges and universities, combined with the results of expert surveys and interviews, a quality evaluation index system for college graduates' innovation and entrepreneurship education was established in this paper.

This paper constructed an evaluation model of innovation and entrepreneurship education for college graduates based on BP neural network, and introduced the parameter determination in detail. By taking S University as an example, the model constructed in this paper was used to evaluate the quality of college graduates' innovation and entrepreneurship education.

The evaluation results showed that the current innovation and entrepreneurship education in S University is at a medium level, and there are problems such as the missing educational concepts and insufficient teacher resources, targeting on these problems, this paper proposed corresponding improvement suggestions.

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