Graduates' Innovation and Entrepreneurship Ability under the School-enterprise Integration Mode

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Abstract: The article constructs the evaluation system of postgraduate innovation and entrepreneurship education from four aspects: country, school, student and society. The analytic hierarchy process is used to determine the weight of indicators at all levels. The mathematical model of fuzzy comprehensive evaluation of postgraduate innovation and entrepreneurship is constructed. Finally, the example is verified by examples. The rationality and reliability of the evaluation method of postgraduate innovation and entrepreneurship system combined with AHP and fuzzy comprehensive evaluation have important practical guiding significance.

1. Introduction

With the continuous development of the market economy, the knowledge structure of talents has been diversified, and the proportion of graduate students nationwide has increased year by year. In the process of cultivating talents, colleges and universities pay more attention to applied and comprehensive talents, aiming at improving students' innovative ability, practical ability and increasing social integration. In the aspect of talent cultivation, colleges and universities are paying more attention to which students are suitable as the object of the innovation and entrepreneurship evaluation system and how to evaluate the graduate innovation and entrepreneurship system.

2. The construction of graduate innovation and entrepreneurship system

2.1. Review of Literature

The results of Helle Johnsen (2016) [1] show that innovation is driven by teamwork, professional involvement, mentoring, and external partnerships. Andreas Riel and Serge Zhang Jianping (2018) [2] studied the development status, drawbacks and solutions of graduate entrepreneurship education. Zhang Xin (2018) [3] uses fuzzy analytic hierarchy process and takes young students as the research object. From the analysis of family, university, enterprise and government, the importance of young students' innovation and entrepreneurship is as follows: entrepreneurial practice, innovative thinking, innovative knowledge.

2.2. Establish an evaluation index system

According to the above definition, this paper determines that the first-level indicators of graduate innovation and entrepreneurship system are composed of four dimensions: government, school, student and employment unit. According to the relative independence of each index, the internal dimension compatibility of the same dimension, the principle of goal consistency, and in accordance with the principles of feasibility, measurability and completeness, this paper has carried out the index system of postgraduate innovation and entrepreneurship system under the school-enterprise integration mode. Initial construction. As shown in Table 1.

Table 1. Index system table of graduate student innovation and entrepreneurship evaluation

One-level Indexes	Two-level Indexes
Government aspect	Policy Support
	Funding investment
School aspect	Innovation and entrepreneurship education concept
	Innovation and entrepreneurship curriculum design system
	Teaching practice platform
	Spiritual culture
Student aspect	Self-employment awareness
	Practice results
	Entrepreneur ratio
Employment unit	School and enterprise joint construction
	School-enterprise recognition

3. Fuzzy comprehensive evaluation method and steps

3.1. Establishment of Factor Set

Based on evaluation index system, by sorting out and analyzing problems, classifying various factors, factor set is determined. We suppose factor set $U=\{U_1,U_2,...,U_n\}$ which is made up of elements that affect the judgment objects. According to evaluation index system and the analysis above, the factor set can be established.

$U=\{U_1,U_2,U_3\}$, $U_1=\{u_{11},u_{12},u_{13}\}$, $U_2=\{u_{21},u_{22},u_{23}\}$, $U_3=\{u_{31},u_{32},u_{33}\}$, $U_4=\{U_{41},U_{42},U_{43}\}$

There are 11 single factors affecting customer experience for index system for postgraduate innovation and entrepreneurship evaluation, and they can be divided into two tiers.

3.2. Establishment of Weight Set

The impact indicators of postgraduate innovation and entrepreneurship education evaluation are based on the actual experience of the graduate group. To reflect the differences, every factor is endowed with corresponding weight.

And factor weight set can be established as $W=(w_1,w_2,\cdots,w_n)$.

3.2.1. Establish a multi-level evaluation model

In order to reflect impact effect of indexes effect objectively and scientifically, the research adopts Analytic Hierarchy Process (AHP) to determine the index weight, and transfer the qualitative problem into the quantitative calculation. Every factor has different importance degree.

3.2.2. Establish a comparison judgment matrix

First, establish the comparison judgment matrix. Membership between the up-down hierarchy members is determined after we establish the multi-level evaluation model. Draw the pairwise comparison between elements in each hierarchy of the multi-level model for the correlative up-level element, and then establish a series of judgment matrixes as follows:

$$A-B_i=\begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \cdots & \cdots & \ddots & \cdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} \quad (1)$$

In the formulation, $b_{ij}>0$, $b_{ij}=1/b_{ji}$, $b_{ii}=1$. b_{ij} stands for the importance proportion scale of B_i and B_j for the correlative up-level element A. When drawing the pairwise comparison between elements, one-to-nine scale method is usually adopted as shown in Table 2.

Table 2 The definition of scale method

Scale	Definition description
1	The equal importance of two elements comparison.
3	The former is a little more important than the latter.
5	The former is obviously more important than the latter.
7	The former is mightily more important than the latter.
9	The former is extremely more important than the latter.
2,4,6,8	The intermediate values of adjacent judgments above.

3.2.3. Calculate the relative weight of elements under a single criterion

The research computes the max characteristic root and characteristic vector through judgment matrix; uses characteristic root method to compute collating weight vector and supposes that the max characteristic root of judgment matrix is $\lambda_{\max}$, and the corresponding characteristic vector is W. The calculation method is as follows:

Firstly, multiply elements of according to line; secondly, extract gained products for n times; then, normalize the root vector and get the collating weight vector, as follows:

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{\sum_{i=1}^{n} b_{ij}\omega_i}{n\omega_i} (i = 1, \cdots, n) \quad (2)$$

$$\omega_i = \sqrt[n]{\prod_{j=1}^{n} b_{ij}} \Big/ \sum_{j=1}^{n} \sqrt[n]{\prod_{j=1}^{n} b_{ij}} (i = 1, \ldots, n) \quad (3)$$

Conduct consistency check. It is necessary for the consistency check of $\lambda_{\max}$, in order to make sure that the decision-making process is scientific. Compute CI, as follows:

$$CI = (\lambda_{\max} - n)/(n-1) \quad (4)$$

In the formula, CI is coincidence index, and n is the order of the matrix. Compute CR:

$$CR = CI / RI \quad (5)$$

In the formula, CR is coincidence rate, and RI is random coincidence index, whose values are in Table 3.

Table 3 Random coincidence indexes of judgment matrix

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

When CR<0.1, the research considers that judgment matrix has a good consistency, or else needs to adjust the values of elements in judgment matrix.

3.2.4. Calculate the combined weights of the elements of each layer

By determining the value of CR, the relative weight of each layer target to the total target is obtained. When CR⩾0.1, the elements of the matrix need to be properly adjusted, and the total judgment consistency test is completed from top to bottom. Through calculation, the relative weight of each indicator and the consistency test of the entire hierarchical model are obtained.

3.3. Establishment of Evaluation Set

Suppose evaluation set $V = \{V_1, V_2, ..., V_m\}$, which is made of all kinds of total judgment results given by judges as elements. The evaluation set V of postgraduate innovation and entrepreneurship system can be established with five evaluation results, namely, V={excellent, good, moderate, common and bad}.

3.4. Fuzzy Comprehensive Evaluation

First, postgraduate innovation and entrepreneurship system evaluate from the single element of factor set U and experts determine the degree of membership that the evaluation objects rely on the elements of factor set. Then, the research establishes the total evaluation matrix consisting of evaluation sets of n elements. It is usually expressed as R. After getting values of W and R, the research can do fuzzy mapping to have a comprehensive judgment. The mathematical model of fuzzy comprehensive evaluation is shown as:

$$B = W \cdot R \qquad (6)$$

4. Application Example Analysis

On the basis of consulting experts and researching a large number of relevant theoretical research, based on the current situation of postgraduate innovation and entrepreneurship education under the school-enterprise integration model, the fuzzy comprehensive evaluation of postgraduate innovation and entrepreneurship ability under the school-enterprise integration model.

Based on the previous research on structural equation model, this study establishes an index system for postgraduate innovation and entrepreneurship evaluation based on the four dimensions of government, school, student and employment unit, and combines the analytic hierarchy process with the fuzzy evaluation method. The method establishes a mathematical model, as shown in Figure 1.

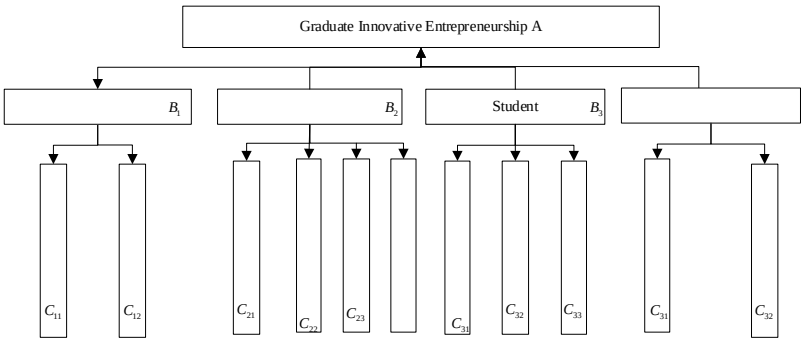

Figure 1 Step-down hierarchical model of customer experience for the evaluation system of postgraduate innovation and entrepreneurship education

According to Fig .1 above, structure the judgment matrix $A-B_i$ as shown in Table 4.

Table 4 Table of judgment matrix $A-B_i$

$A-B_i$	B_1	B_2	B_3	B_4
B_1	1	1/4	1/3	2
B_2	4	1	3	2
B_3	3	1/3	1	4
B_4	1/2	1/2	1/4	1

Similarly, establish the judgment matrixes of C-level elements for correlative B-level elements.

Based on Formula (2) and (3), calculate and get: λ_{max} =4.3857, W_B=(0.1340,0.4644,0.2967,0.1049). W is the weight set of B-level elements for the general goal. Based on Formula (4), calculate and get: CI=0.1286. When n=3, RI=0.90.Based on Formula (5), calculate and get: CR=0.1429<0.10.This indicates that the judgment matrix has a satisfying consistency. Similarly, calculate all weights of evaluation indexes of customer experience of this enterprise as shown in Table 5.

Table 5 Relative weight of postgraduate innovation and entrepreneurship evaluation indicators

B -level indexes	Weight	*C* -level indexes	Weight
Government aspect	0.6667	Policy Support	0.0893
	0.3333	Funding investment	0.0447
School aspect	0.4469	Innovation and entrepreneurship education concept	0.2075
	0.3342	Innovation and entrepreneurship curriculum design system	0.1552
	0.1386	Teaching practice platform	0.0643
	0.0803	Spiritual culture	0.0372
Student aspect	0.6738	Self-employment awareness	0.1999
	0.1007	Practice results	0.0299
	0.2255	Entrepreneur ratio	0.0669
Employment unit	0.3333	School and enterprise joint construction	0.0349
	0.6667	School-enterprise recognition	0.0699

According to the results of Table 5, calculate and get combination weight:

W=(0.0893, 0.0447, 0.2075,0.1552,0.0643,0.0372,0.1999,0.0299,0.0669,0.0349,0.0699).

Evaluating factor set U is made up of eleven factors influencing postgraduate innovation and entrepreneurship evaluation. Evaluation set V is established with five evaluation results for the factors: excellent, good, moderate, common and bad. According to customers' test data of postgraduate innovation and entrepreneurship evaluation, establish estimation matrix as shown in Table 6.

Table 6 Estimation matrix R

	Excellent	Good	Moderate	Common	Bad
Policy Support	0.20	0.30	0.40	0.10	0
Funding investment	0.10	0.40	0.50	0.10	0
Innovation and entrepreneurship education concept	0.20	0.30	0.30	0	0
Innovation and entrepreneurship curriculum design system	0.20	0.30	0.30	0	0
Teaching practice platform	0.20	0.30	0.30	0	0
Spiritual culture	0.30	0.50	0.20	0	0
Self-employment awareness	0.30	0.60	0.30	0	0
Practice results	0.20	0.30	0.30	0.10	0
Entrepreneur ratio	0.10	0.40	0.10	0	0
School and enterprise joint construction	0.30	0.40	0.20	0	0
School-enterprise recognition	0.20	0.40	0.30	0	0

Based on Formula (6), calculate: B=(0.21598,0.38896,0.29719,0.01639).

According to the maximum membership degree method, the relevant enterprises organized 10 experts to evaluate the comprehensive status of graduate innovation and entrepreneurship: the maximum membership value is max(bi)=0.38896. It can be concluded that the evaluation system model of graduate innovation and entrepreneurship is at the second level of evaluation, that is, the expert evaluation experience of the graduate innovation and entrepreneurship evaluation system

under the school-enterprise integration mode is good.

5. Conclusions

The research done in this paper can be summarized as follows: This paper uses the combination of AHP and fuzzy comprehensive evaluation method to evaluate the postgraduate innovation and entrepreneurship ability system under the school-enterprise integration mode, so as to avoid the subjective preference of people in the analytic hierarchy process. According to the research conclusions of the article, the application of AHP fuzzy evaluation method in the evaluation system of postgraduate innovation and entrepreneurship education is effective and can be widely promoted.

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