Employment confidence index of college students with engineering majors based on BP-ANN and AHP

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ABSTRACT: In recent years, China's employment rate among college students with engineering majors has been decreasing, and this is now a serious issue. Based on backward propagation-artificial neural network (BP-ANN) and the analytic hierarchy process (AHP), the employment confidence index (ECI) of college students with engineering majors and their influencing factors were studied. The status of ECI research of college students with engineering majors was reviewed to lay a theoretical foundation for the research. Then, a questionnaire survey among 500 students with engineering majors in China was conducted to determine the factors of influence, through descriptive analysis and correlation analysis. Ten students were sampled randomly for in-depth interviews. Analysis using AHP determined the weights of ECI-related factors. The samples were analysed using BP-ANN to evaluate the ECI-related factors. Finally, the results can be used by universities, colleges, entrepreneurship programmes and other educational institutions to enhance the ECI and employment of college students with engineering majors.

INTRODUCTION

As universities in China expand enrolment, the difficulty of college students with engineering majors in gaining employment has become a serious issue and a destabilising factor for social development. According to statistics from the Chinese Academy of Social Sciences, the employment rate of college students in China has decreased, from 93.24% in 2008 to 90.9% in 2013 [1]. This downward trend has adversely affected the Employment Confidence Index (ECI) of college students with engineering majors. In-depth research on ECI-related factors is reported in this article and is intended to lay a theoretical foundation for promoting employment of college students with engineering majors.

ECI RESEARCH OF COLLEGE STUDENTS

A confidence index put forward by the company, Barron's, is used for trend assessment in securities market. It is widely used today to mirror the level of prosperity in employment, production growth and industrial development [2]. The Randstad Employment Confidence Index (ECI) has become popular in research of college students' employment and can provide a better understanding of employment trends for college students [3]. In earlier works, researchers studied factors related to ECI of college students in the context of employment difficulties and pointed out that social factors and family factors were involved in ECI [4].

The research investigated 650 college graduates of 2013, from Beijing, Shijiazhuang, Zhengzhou and Yantai. The research method used a questionnaire survey, with 650 questionnaires given out and all returned for a recovery rate of 100%. Of the respondents, 176 were from Beijing, 159 from Shijiazhuang, 185 from Zhengzhou and 130 from Yantai; 342 were male and 308 were female graduates; 331 were from urban areas and 319 were from rural areas; 180 majored in computer science, 126 majored in civil engineering, 147 majored in safety science and engineering, and the rest, 197, were from other arts and economics majors.

The overall ECI of college students is low: the research shows that the average ECI is 11.5, which is low. The minimum is 3 and the maximum is 18. The average ECI of male graduates is 13.5 while that of female graduates is 10.5. The average ECI of urban students is 13 while that of rural students is 11, which is slightly lower. The ECI of engineering students is 13.5, obviously higher than that of other majors.

ECI-related factor research: The ECI indicator hierarchy of college students was established using AHP (analytic hierarchy process), and a relevant weighting index set. The indicator hierarchy is shown in Figure 1. The preliminary evaluation criteria are determined by correlation analysis, and the weights of evaluation factors derived by AHP, the details of which are provided below. Based on earlier studies, the influencing factors determined are family, personal, college and social [3][5][6]. The ten (10) specific factors studied are indicated in Table 1.

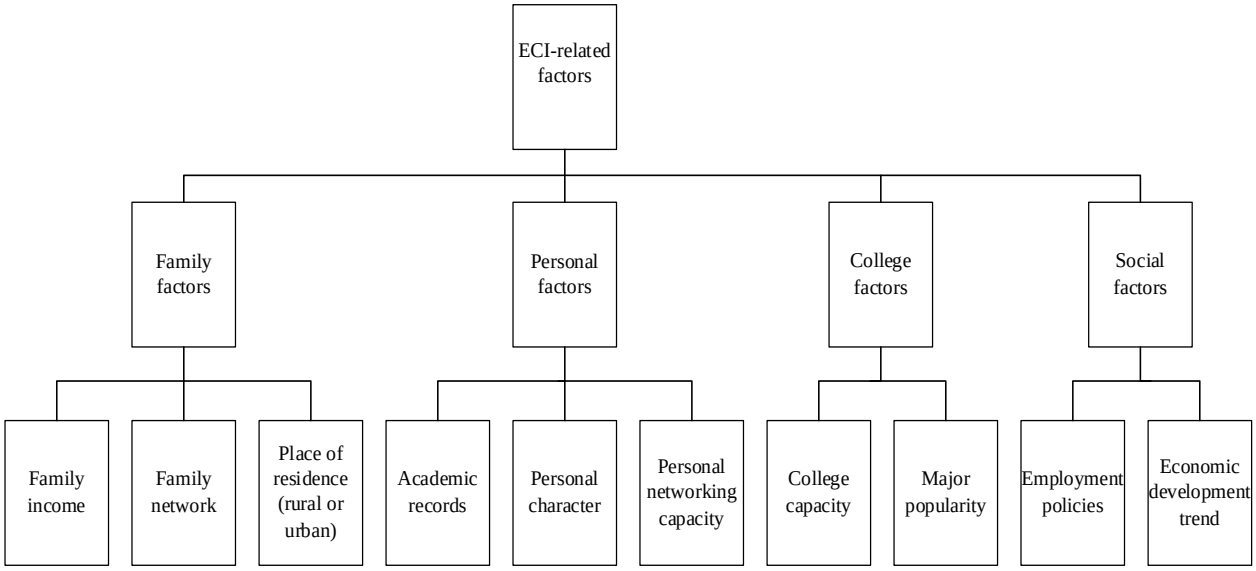

Figure 1: General structure chart of ECI-related factors.

SPSS 2.0 was used to calculate the Pearson correlation coefficients of ECI-related specific factors as indicated in Table 1. One should note that all the factors are smaller than 0.01 and the correlation coefficients are greater than zero, which shows a significant correlation.

Table 1: Correlation analysis of ECI-related specific factors.

	Pearson correlation	Significance (two-sided test)	Number (N)
Family income	0.692*	0.000	650
Academic record	0.805*	0.000	650
National supportive policies	0.822*	0.000	650
Place of residence	0.426	0.002	650
Popularity	0.584*	0.004	650
Family network	0.812	0.001	650
Character	0.356	0.002	650
Personal networking	0.652	0.000	650
College publicity	0.675	0.003	650
Economic development trends	0.802	0.000	650

* significantly corrected at the 0.01 level (two-sided test).

ECI-RELATED FACTOR ANALYSIS THROUGH AHP

This research initially established the reliability and validity of the ECI-related factors by means of correlation analysis. Ten specific factors were, then, screened out for further analysis, viz. family income, academic record, national supportive policies, place of residence, popularity, family network, character, personal networking, college publicity and economic development trends. A Delphi survey method was employed. Ten students were sampled for in-depth interviews. The initial indicator system was further corrected and verified, and the weighting of indicators established. The four 2nd-level and ten 3rd level indicators were evaluated in-depth. The details are shown in Table 2 and Table 3.

Table 2: Analysis of ECI-related factors.

	1st level indicators	2nd level indicators
ECI-related factors	Family factors B_1	Family income C_{11}
		Family network C_{12}
		Place of residence C_{13}
	Personal factors B_2	Academic record C_{21}
		Personal character C_{22}
		Personal networking C_{23}
	College factors B_3	College publicity C_{31}
		Popularity C_{32}
	Social factors B_4	National supportive policies C_{41}
		Economic development trend C_{42}

Table 3: Weighting scale of ECI-related factors.

Weight scale of ECI=related factors	1st level indicators	Weight	2nd level indicators	Weight
	Family factors B_1	0.3825	Family income C_{11}	0.4824
			Family network C_{12}	0.2357
			Place of residence C_{13}	0.0893
	Personal factors B_2	0.1322	Academic records C_{21}	0.2361
			Personal character C_{22}	0.3894
			Personal networking C_{23}	0.0938
	School factors B_3	0.3215	College publicity C_{31}	0.0392
			Popularity C_{32}	0.1533
	Social factors B_4	0.0369	National supportive policies C_{41}	0.3889
			Economic development trend C_{42}	0.0953

In-depth interviews were conducted on the 10 selected students. Then, ECI-related factors were investigated, and the 10 factors were evaluated using the Likert method. The results have five levels, i.e. 5 - extremely strong correlation, 4 - relatively strong correlation, 3 - neutral, 2 - weak and 1 - no correlation. The ECI correlation score matrix was then obtained. Multiplying by the weights of the indicators yields the weight matrix. The results are shown in Table 4.

Table 4: Evaluation of ECI-related factors.

	C_{11}	C_{12}	C_{13}	C_{21}	C_{22}	C_{23}	C_{31}	C_{32}	C_{41}	C_{42}	Evaluation results
1	3	4	1	2	3	4	5	3	5	3	3.3856
2	2	3	5	5	1	2	3	3	4	4	3.2653
3	4	3	5	3	5	4	5	2	1	5	3.8689
4	5	4	2	4	5	4	3	2	3	3	3.6536
5	4	3	2	3	4	5	3	4	3	4	3.5456
6	3	4	5	3	3	4	5	3	3	5	3.8482
7	2	2	4	5	3	4	3	4	5	4	3.6332
8	3	5	4	2	1	4	2	2	4	3	3.0051
9	4	2	1	4	2	3	2	3	4	2	2.7693
10	2	3	4	5	3	5	5	3	2	5	3.7263

BP-ANN ANALYSIS OF ECI-RELATED FACTORS

A quantitative analysis of ECI-related factors using the BP-ANN (backward propagation-artificial neural network) model is shown in Figure 2. The ECI-related factors are input vectors and the outputs are evaluation results. The network model uses an adequate training sample to develop the weightings of ECI-related factors, leading to the BP network structure.

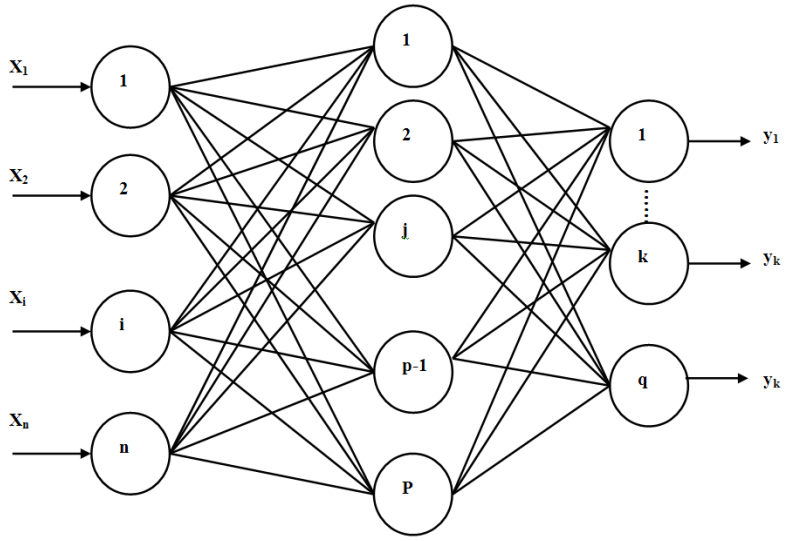

Figure 2: BP-ANN model.

The steps were as followings: normalise the data obtained from Table 5, apply Matlab 7.0 neutral network toolbox to *train* the data obtained from Tables 1-4, converge on the results with 500 learning sessions. The procedure is shown in Table 5.

Table 5: BP-ANN test results.

Input layer	Factor	1	C_{11}
		2	C_{12}
		3	C_{13}
		4	C_{21}
		5	C_{22}
		6	C_{23}
		7	C_{31}
		8	C_{32}
		9	C_{41}
		10	C_{42}
	Unit number*		32
Hidden layer	Number of hidden layers		1
	Unit number in the 1st hidden layer*		6
	Activation function		Hyperbolic tangent function
Output layer	Dependent variable	1	ECI
	Unit number		3
	Activation function		Softmax
	Error function		Cross entropy

* Deviation unit excluded

After training, BP-ANN testing samples were tested. The final test results are shown in Table 6. The error values are less than 5%, which shows that the neural network is reliable. The evaluation network model for the ECI-related factors and the input evaluation indicators of the students, determines the significance of the factors.

Table 6: BP-ANN test results.

	8	9	10
Training result	3.0371	2.7392	3.8262
Expected output	3.0152	2.7170	3.8521
Error	3.5%	2.2%	-1.3%

From the analysis using AHP and BP-ANN supported by previous research, it is seen that some index values differ for engineering majors versus other majors. The coefficients for family, personal, and college factors are relatively high, while the social factors are relatively low. Hence, more attention should be paid to such aspects as the family relationship network, academic record, college supportive policies, student popularity, character and networking. Therefore, improving these factors should enhance the ECI and employment rate of college students with engineering majors. The analysis results above show that the study reported in this article is effective and the related conclusions can be applied to the practice of employment guidance in universities.

CONCLUSIONS

The study used the BP-ANN and AHP to weight and evaluate the ECI and its influencing factors among college students with engineering majors in China. The obtained results can be used by universities, colleges, entrepreneurship programmes and other educational institutions to enhance the ECI and employment of college students with engineering majors.

ACKNOWLEDGEMENTS

The study was supported by the Livelihood research topic, Analysis and Research on Female College Students' Employment in Hebei Social Science Development Research Project of 2012 (Project No. 201201193) and *Hebei Soft Science Project* Research on Youth Employability Training System of Hebei Province of Hebei Science and Technology Department (Project No. 12457666).

REFERENCES

1. Qingjun, W., Analysis and research on employment predicament of university students. *J. of Sustainable Develop.*, 1, **2**, 107-110 (2008).
2. Rong, Y., The research of how to effective implementation the political education in employment guidance for university students. *Proc. Inter. Conf. on Mechanical, Industrial, and Manufacturing Engng.*, Singapore, 238-242 (2012).
3. Yang, G., Measurement and empirical study of employment confidence index of college students-taking Dezhou City in Shandong Province as an example. *Inner Mongolia Science Technol. and Economy*, **24**, 6-7 (2012).

4. Guo, X. and Wen, N., Determination index studies on employment difficulties of college students on campus. *Higher Educ. of Social Science*, 3, **3**, 30-32 (2012).
5. Wen, N., and Guo, X., Rational thinking upon entrepreneurship education of college students. *Higher Educ. of Social Science*, 3, **3**, 41-44 (2012).
6. Mei, G. and Yuan, S., Cross-cultural communication competence for science and engineering college students: survey and proposal. *Theory and Practice in Language Studies*, 3, **7**, 1136-1142 (2013).