

# *Empirical Research on the College Students' Employability Affect Factors of GIS Major Based on Factor Analysis*

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**Abstract**—Factor analysis method was used the research on the college students' employability affect factors of GIS major based on 325 college students' effective samples of GIS major of five universities of Hebei Province, China. It used 22 evaluation indicators and extracted 5 evaluation factors to research the affect factors. The result showed that the 5 evaluation factors had higher total influence which reached 4.01. The degree of influence ranged from large to small, self-capacity factor, college factor, enterprise factor, government social factor, and family factor. Among them, self-ability factor and university factor played a major role, and their variance contribution rate reached 22.21% and 17.00%.

**Keywords**—*factor analysis; employability; affect factors; GIS*

## I. INTRODUCTION

The employment of college students had always been a key focus issue of our country, government department and university. It was not only related to the realization of personal future and its own value, but also a major event related to social and economic development and social stability[1]. Recent years, with the continuous development of GIS technology, it had been widely used in many fields of national economic construction such as agriculture, forestry, water conservancy, land, transportation, and urban planning. In order to meet the needs of society and the market, many universities set up GIS major. Under the situation of diversified development of the employment market and increasingly fierce employment competition, it was significant for the government department and university to study how to improve their own level and improve their employment. It had urgent practical significance and far-reaching history for rationally guiding the construction and development of GIS disciplines to effectively adapt to the needs of society and the market[2].

Based on the survey data of five universities undergraduate students of GIS major of Hebei Province, the research independently designed questionnaire system of influence factors about the employment of GIS major college students of Hebei Province. With the support of SPSS 20.0, the paper used factor analysis model and

constructed a scale to extract and analyze the impact of different factors on the employment ability of GIS majors.

## II. EASE OF USE

### A. Questionnaire Compilation

China scholars completed a lot of research on the influence factors of the employability of college students. For example, Cheng Wei collected and analyzed the statistical data in his paper Research on Employment Ability of College Students, and extracted the factors that affect the promotion of College Students' employment ability. According the result of the research, he proposed the five key factors: specialty setting, career planning, evaluation and incentive, campus culture and teaching ability[3]. Zhao Jun, in his paper The Study on the Employment Ability of College Students Based on Factor Analysis, put forward that physical and mental qualities were the main influence factors of the college students employability, followed by the quality of applicants, professional level, social ability and cultural achievements[4]. Huang Ling and Yang Penghui designed three aspects to evaluate the influence factors of college students' employment in the paper The Study of the Composition of College Students' Employment Ability Based on Principal Component Analysis. They put forward that most influential factors were attitude and cooperation ability, career planning and management, learning and enterprising ability, and professional skills application ability[5].

On the basis of analyzing and summarizing the influence factors of college students' employability, through visiting and investigating the relevant government departments, GIS enterprise, universities and college students of Hebei Province, and based on exploratory factor analysis of the valid samples of the survey data, the paper put forward a pentagonal model of the influence factors of college students employability of GIS major and designed a questionnaire system. Five dimensions were selected as the first-level evaluation factors of the influence factors of the employment of GIS major including government and society, employer, university, self ability, family factor, and 22 variables were selected as the second-level evaluation indicators, including business demand (X11), employment policy (X12), enrollment scale (X13), employment market (X14),

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corporate culture(X21), welfare remuneration(X22), enterprise location(X23), career development(X24), training target(X31), curriculum setting(X32), teaching mode(X33), employment guidance(X34), evaluation and assessment(X35), school-enterprise cooperation(X36), campus culture(X37), physical and mental quality(X41), social ability(X42), learning ability(X43), professional skill(X44), applicant quality(X45), economic situation(X51) and concept of employment(X52).

It used Likert's five-level positive scoring method, and selected 22 secondary indicators to evaluate the data according to the degree of impact. And also according to the five levels of very small impact, small impact, general, large impact, very large impact, the corresponding scores were 1, 2, 3, 4 and 5.

**B. Sample Statistics and Test**

At present, there were 5 universities including Hebei Normal University, North China University of Technology, Hebei University of Engineering, Yanshan University and Hebei Geological University set up GIS major in Hebei Province, China. Through the relevant personnel of colleges and universities, 338 samples of data were collected and then removed 13 unqualified questionnaires which the repetition rate was more than 5%. At last, 325 valid statistical samples were collected. The sample efficiency was 97.01%. Meanwhile, Krone Bach's alpha coefficient was used to test the reliability of the questionnaire in SPSS20.0.

$$\alpha = \left( \frac{k}{k-1} \right) \cdot \left( 1 - \frac{\sum a_i^2}{\sum a_t^2} \right) \quad (1)$$

Among them,  $\alpha$  represented credibility,  $k$  represented the number of items in the scale,  $a_i$  represented the variance ( $i = 1, 2, \dots, k$ ) of the score of all visitors in item  $I$ ,  $a_t$  represented the variance ( $t = 1, 2, \dots, k$ ) of the total scores of all visitors, and the total scores referred to the total scores of each item.

The analysis results were shown in Table I.

TABLE I. SAMPLE RELIABILITY TEST VALUES

Index Code	Items	Samples	$\alpha$ Coefficient
X1	4	325	0.793
X2	4		0.748
X3	7		0.900
X4	5		0.891
X5	2		0.782

The results showed that the coefficient of government and society was 0.793, the coefficient of employer was 0.748, the coefficient of university was 0.900, the coefficient of self-ability was 0.891, and the coefficient of family factor was 0.782. The coefficients of the five dimensions used in the questionnaire were all greater than 0.7 and had high internal consistency.

**III. PROCESS OF RESEARCH AND ANALYSIS**

**A. Factor condition test**

Factor analysis of samples was used to get validity test value by SPSS20.0. The following Table II showed the results.

TABLE II. KMO AND BARTLETT TEST VALUES

Kaiser-Meyer-Olkin metric for sampling sufficiency		0.929
Bartlett sphericity test	Approximate chi-square	1306.911
	df	231
	Sig.	0.000

In general, the analysis effect was the best when KMO's statistical value was greater than 0.9. The analysis result showed that  $KMO=0.929 > 0.9$ , so the method of factor analysis was feasible. At the same time, the statistical value Sig. of Bartlett spherical test was 0.000, far less than 0.05, which further illustrates that there was a strong correlation among the 22 elements.

**B. Factor extraction**

The 325 valid samples collected were imported into SPSS 20.0. Factor analysis was carried out by dimension reduction module. Five principal components were obtained by extracting factor characteristic values which was greater than 1. The scree plot was also obtained which was shown in Fig. 1.

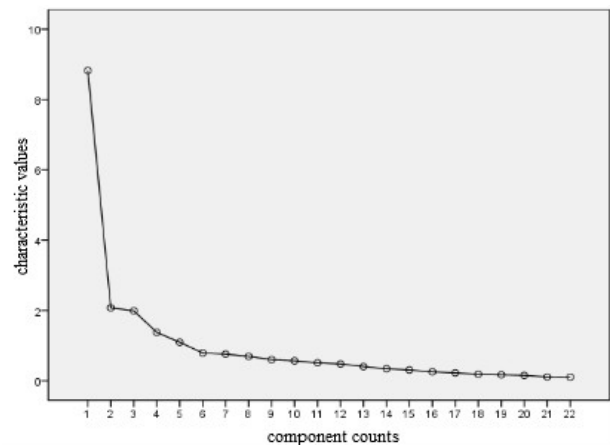


Fig. 1. Characteristic values scree plot

After the fifth factor, the characteristic values of the components were less than 1, and the change of the characteristic values was slow. Therefore, according to the principle that the characteristic values were greater than 1, the first five factors were extracted. In order to get more detailed analysis results, the samples were rotated orthogonally and converged after 9 iterations. The results showed that the cumulative variance contribution rate of the extracted common factors reached 69.811%, which contained most of the data information of the original variables. Therefore, the original 22 variables were classified into 5 evaluation factors for analysis. The results were shown in Table III.

**TABLE III. RESULTS OF FACTOR ANALYSIS**

Common Factor	Evaluate Indicator	Factor load	Characteristic Values	VCR
Y1 Self ability	X43	0.817	4.887	22.21%
	X44	0.805		
	X45	0.776		
	X42	0.708		
	X41	0.675		
Y2 Universiy	X32	0.769	3.741	17.00%
	X33	0.739		
	X31	0.735		
	X36	0.734		
	X34	0.644		
	X35	0.635		
Y3 Employer	X22	0.751	2.607	11.85%
	X21	0.750		
	X24	0.645		
	X23	0.516		
Y4 Government and society	X12	0.850	2.220	10.09%
	X14	0.765		
	X13	0.744		
	X11	0.554		
Y5 Family factor	X52	0.878	1.903	8.65%
	X51	0.818		

\*VCR: Variance Contribution Rate

It was found that the first principal component included five indicators: learning ability, professional skill, applicant quality, social ability, physical and mental quality, which reflected the impact of their own quality. The second principal component included seven indicators, including curriculum setting, teaching mode, training target, school-enterprise cooperation, employment guidance, evaluation and assessment, and campus culture, which reflected the impact of university. The third principal component included four indicators, including welfare remuneration, corporate culture, career development, and enterprise location, which reflected the impact of enterprise. The fourth principal component included four indicators:

employment policy, employment market, enrollment scale and business demand, which reflected the impact of the government and society. The fifth principal component included the concept of employment and economic situation, which reflected the impact of the family.

### C. Comprehensive evaluation function calculation

In order to reflect the affect factors of employment ability of GIS major, factor analysis was needed to find out the comprehensive impact. factor scores coefficient matrix was obtained by the analysis of effective samples . The results were shown in Table IV.

**TABLE IV. FACTOR SCORES COEFFICIENT MATRIX**

Evaluation Index	Component				
	1	2	3	4	5
X11	-0.088	-0.003	0.38	0.273	0.297
X12	-0.056	-0.105	0.392	0.055	0.018
X13	-0.041	0.161	0.298	-0.015	-0.094
X14	-0.038	-0.009	0.339	0.012	-0.112
X21	-0.071	-0.120	0.033	0.468	0.034
X22	0.204	-0.006	0.001	0.161	0.079
X23	0.131	-0.070	0.027	0.190	0.031
X24	0.160	-0.001	-0.051	0.110	0.020
X31	-0.020	0.098	0.008	0.219	-0.060
X32	-0.104	0.167	-0.005	0.235	-0.122
X33	-0.001	0.221	0.001	0.198	-0.122
X34	-0.067	0.321	0.003	-0.143	-0.025
X35	-0.047	0.246	-0.043	-0.131	0.146
X36	0.085	0.208	-0.017	-0.110	-0.026
X37	-0.075	0.299	-0.074	-0.073	0.029
X41	0.173	0.016	-0.026	-0.046	-0.019
X42	0.233	0.048	-0.082	-0.282	0.067
X43	0.226	-0.065	-0.076	0.007	-0.018
X44	0.232	-0.089	0.034	-0.068	-0.056
X45	0.214	-0.055	0.035	-0.104	-0.005
X51	0.018	-0.037	-0.001	-0.077	0.456
X52	-0.017	-0.009	-0.086	0.021	0.502

The expression of factor score was obtained as follows.

$$Y = \sum_{m=1}^n \alpha_{ij} \bullet X_{ij} \quad (2)$$

Among them, m, n were the evaluation index number,  $\alpha$  was the score coefficient of the evaluation factor of the current component, X was the mean of the original data after the standardization, Y was the score of the current factor, i and j stood for the serial number of the current factor and the evaluation index respectively.

According to the formula, the first principal component expression was  $Y1 = -0.088X11 - 0.056X12 - 0.041X13 - 0.038X14 - 0.071X21 + 0.204X22 + 0.131X23 + 0.16X24 - 0.02X31 - 0.104X32 - 0.131X33 - 0.067X34 - 0.047X35 + 0.025X36 - 0.075X37 + 0.173X41 + 0.233X42 + 0.226X43 + 0.232X44 + 0.214X45 + 0.018X51 - 0.017X52$ .

Similarly, other factors Y2, Y3, Y4, and Y5 could be scored. After calculation, the final factor score was: self-ability factor Y1 = 4.51, university factor Y2 = 4.35, employer factor Y3 = 3.83, government and social factor Y4 = 3.34, family factor Y5 = 3.03.

The expression of the overall influence degree [6]:

$$Y = 0.318Y1 + 0.244Y2 + 0.17Y3 + 0.145Y4 + 0.124Y5 \quad (3)$$

After calculation, Y=4.01.

**D. Index weight and influence degree score**

Calculated the weight of each factor according to the variance contribution rate of the five extracted components, and analyzed the influence degree of the sample data. The results were shown in Table V.

TABLE V. RELATIVE WEIGHT AND INFLUENCE DEGREE

Component	Secondary Level Index	Influence Degree	Relative Weight
1	X43	4.22	31.82%
	X44	4.31	
	X45	4.07	
	X42	3.73	
	X41	3.95	
2	X32	3.86	24.36%
	X33	3.74	
	X31	3.82	
	X36	3.79	
	X34	3.71	
	X35	3.46	
3	X37	3.38	16.97%
	X22	4.00	
	X21	3.44	
	X24	4.05	
4	X23	3.89	14.45%
	X12	3.49	
	X14	3.46	
	X13	3.49	
5	X11	3.62	12.39%
	X52	3.03	
	X51	2.96	

The analysis result showed that self-ability had the greatest impact, with its relative weight reached 31.82%, followed by

university reached 24.36%. Employers, government and social levels reached 16.97% and 14.45% respectively. Family factor was the smallest impact reached 12.39%. From the single value of the impact, the highest score were professional skills (4.31), the lowest was family economic status (2.96).

**IV. CONCLUSIONS**

- According to the mathematical model of factor analysis, the influence degree of the five factors on the employment ability of GIS major was self-ability factor, university factor, employer factor, government social factor and family factor. The highest influence degree of self-ability was professional skill. The highest influence degree of university was curriculum setting. The highest influence degree of employer was welfare remuneration. The highest influence degree of government and social was the business demand. The highest influence degree of family factor was the concept of employment.
- The overall influence degree of the selected evaluation factors which researched 4.0 were relatively high considered by the college student of GIS major. Among them, the factors of self-ability and university generally had a greater impact, the scores were 4.51, 4.35, significantly higher than the other several factors. Therefore, these two aspects should be emphasized in order to improve the employability of GIS major college students.
- Self-ability factor was the most important factor. According to the calculation, the variance contribution rate of self-ability factor reached 22.21%, and its weight reached 31.82%, which was significantly higher than other factors.

The research showed that there was a high degree of correlation, interdependence and mutual restriction among the factors. Therefore, in order to improve the employment ability of the college students of GIS major, it is necessary to improve their own ability level, clarify the training objective of colleges and universities, improve and perfect the training program, set up courses reasonably and carry out corresponding teaching modes. It is necessary not only to change the existing assessment methods of emphasizing theory and neglecting practice in most colleges and universities, but also to change the standards and methods of the results of GIS personnel training, so as to make it tend to pay equal attention to both theory and practice assessment, and pay equal attention to the training of skilled and innovative personnel.

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