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Research on Reconstruction of Practical Teaching System Based on Employment Quality under the Background of Big Data —A Case of Our School's Applied Statistics Major

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Abstract: ***In the current statistical teaching system in China, there are disadvantages such as the disconnection between the teaching content and the era of big data, the lack of statistical practice courses, limited practical teaching resources, single practice teaching methods, and weak practice teaching. Starting from the practical ability required by applied statistics professionals in the era of big data, the employment quality of the 375 statistics majors who graduated from our school in 2012-2019 and its impact on the faculty structure, curriculum structure, and practical teaching of the statistics department during school investigate and analyze attitudes in other areas. First of all, using AHP-BP neural network method (AHP-BP) to establish a set of college students employment quality evaluation model, the maximum relative error is 0.00116. Then, according to the evaluation value of employment quality, the graduates are divided into high employment quality graduates and low employment quality graduates. Through comparative analysis, it is found that graduates with high employment quality are significantly less satisfied with the teaching practice courses offered during the school period than those with low employment quality (χ^2 = 35.032, p = 0.000). The graduates with high employment quality think that the college needs to improve in terms of internship, faculty, teaching facilities, teaching materials, professional course content and arrangements, which is significantly higher than the low employment quality. Finally, three specific measures for restructuring the practical teaching system of applied statistics are proposed.***

Keywords: Statistics major, Employment quality, AHP-BP, Practical teaching.

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1. Introduction

Under the background of the era of big data, with the rapid development of computer technology, the emergence of statistical software, and the continuous optimization of various statistical algorithms, enterprises have increasingly high requirements for the professional quality of statistical talents [1].

However, at this stage, most statistical teaching in colleges and universities is based on basic theory, and most of the time is to teach theoretical knowledge in the classroom. Even if there is a practical link, it is only a simple empirical analysis of the topic of the book, which often ignores the cultivation of students' practical and innovative ability. Moreover, the number of high-quality internship units that the statistics major cooperates with in the school location is relatively small, and it can hardly meet the internship practical needs of statistics majors. The weak practice courses and practical teaching links of statistics majors in colleges and universities make some graduates of statistics have weak practical ability. After entering the job, it takes a long time to be competent for some more difficult statistical work, which leads to poor employment quality [2].

Through the investigation and analysis of the work quality of our statistics graduates and their attitudes towards the faculty structure, curriculum structure, and practical teaching of the statistics department during their time in school, specific measures for restructuring the practical teaching system of applied statistics are proposed.

2. Data and Models

2.1 Data Collection

A total of 386 questionnaires were distributed in this questionnaire survey, and 375 valid questionnaires were recovered. The respondents were graduates majoring in statistics from 2012 to 2019 in our school. Descriptive statistical analysis was performed on the basic information of the 375 valid questionnaires collected. The basic results of the interviewees are shown in Table 1 below.

It can be seen from the table that the number of male students in this survey is relatively large, accounting for 57.6%. The number of students who graduated from 2016 to 2019 is relatively large. 49.9% of the students are members of the Communist Party of China. The number of students who did not serve as student cadres was large, accounting for 66.7%.

Table 1: Statistical analysis of basic information of questionnaire respondents

Investigation items	*Options*	*Number of people*	*Percent (%)*
gender	male	216	57.6
	female	159	42.4
year of graduation	2012	35	9.3
	2013	27	7.2
	2014	34	9.1
	2015	31	8.3
	2016	60	16.0
	2017	51	13.6
	2018	84	22.4
	2019	53	14.1
political status	Communist Party members	187	49.9
	Member of the Communist Youth League	129	34.4
	Independent	59	15.7
Whether to serve as a student cadre	Yes	125	33.3
	No	250	66.7

2.2 Establishment of Employment Quality Evaluation System of University Graduates Based on AHP-BP Method

2.2.1 Index selection

Considering the complexity of the index system and the scientific nature of the research conclusions, on the basis of expert interviews and literature review, an index system for the evaluation of the employment quality of university graduates was constructed, including the target layer, the criterion layer and the index layer, as shown in Table 2.

The target layer is the employment quality of university graduates. The criterion layer includes: employment effects, work benefits, working environment, social insurance, and career development. Among them, the employment effect includes: the counterpart of the work and the major studied, the current stable work and the satisfaction of their work. Work benefits include: satisfaction with one's salary level, satisfaction with one's salary increase opportunities, and satisfaction with company accommodation arrangements. The working environment includes: reasonable working hours, low working pressure, low working intensity, comfortable office environment and getting along well with colleagues. Social insurance includes: the company pays five social insurance and one housing fund, be satisfied with the company's insurance base and supplements the company's insurance. Career development includes: satisfaction with the job training offered by the company, good prospects for the current position and satisfaction with the opportunity for promotion.

The expert evaluation method and the analytic hierarchy process are used to determine the evaluation index and its weight. First, the weight of each indicator is determined by the expert evaluation method, and then the analytic hierarchy process is used to summarize the evaluation weight of the expert, and the rationality of the indicator weight is further tested.

Table 2: Evaluation index system of employment quality of university graduates

Target layer	*Criterion layer*	*Indicator layer*
Employment quality of college graduates	B1 Employment effect	C11 Matching work and major
		C12 Currently stable
		C13 Satisfied with your job
	B2 Work benefits	C21 Satisfied with your salary level
		C22 Satisfied with your chance to raise your salary
		C23 Satisfied with company room and board arrangement
	B3 Work environment	C31 Reasonable working hours
		C32 Low working pressure
		C33 Low working intensity
		C34 Comfortable office environment
		C35 Get along well with colleagues
	B4 Social insurance	C41 The company pays five social insurance and one housing fund
		C42 Satisfied with the company's insurance base
		C43 Satisfied with company supplementary insurance
	B5 Career Development	C51 Satisfied with the job training of the company
		C52 Current job prospects are good
		C53 Satisfied with your promotion opportunities

2.2.2 Construction of judgment matrix of AHP method

By consulting the opinions of a total of 10 experts from the school's recruitment and employment office and the local government, a pairwise judgment matrix was constructed. The pairwise judgment matrix is:

$$B = (b_{ij})_{n\times n} = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{pmatrix} \quad (1)$$

$$b_{ij} > 0, b_{ij} = \frac{1}{b_{ji}}, b_{ii} = 1 \quad (2)$$

For the target layer, in the formula, b_{ij} indicates which of the criterion layers B_i and B_j is more important. Its value is calculated using the "1-9 scale method" in Table 3, and n is the order of the judgment matrix.

Due to the complexity of the hierarchical structure of the evaluation index system and the inevitable subjectivity in the construction of the judgment matrix, in order to ensure reliable results, a consistency test is required. The consistency index CI is:

$$CI = \frac{max - n}{n-1} \quad (3)$$

The random consistency ratio CR is:

$$CR = \frac{CI}{RI} \quad (4)$$

Among them, RI is the average consistency index, as shown in Table 4. The consistency ratios of the five levels are: 0.001, 0.004, 0.000, 0.030, 0.000, 0.004, which are all less than 0.1, indicating that they have passed the consistency test.

2.2.3 Weight calculation of AHP method

Let the weight of the criterion layer indicator B_i be ω_{bi}, which is expressed as follows:

$$\omega_{bi} = \frac{M_i^{\frac{1}{n}}}{\sum_{i=1}^{n} M_i^{\frac{1}{n}}}, M_i = \prod_{j=1}^{n} b_{ij} \tag{5}$$

In the formula: M_i is the product of A and B_i judgment matrix elements of each row. Let the internal weight of the criterion layer belonging to the lower-level indicator C_{ik} of the criterion layer indicator B_i be ω_{cik}, and let ω_{ik} be the total weight of C_{ik} to the target layer [3], as follows:

$$\omega_{ik} = \omega_{bi} \cdot \omega_{cik}$$

After further calculation, the weights of the criterion layer and the indicator layer are shown in Table 5.

The criterion layer is ranked by weight as employment effect, career development, work welfare, working environment and social insurance. The employment effect has the greatest influence on the employment quality of college graduates. The second is career development. Then there are work benefits, working conditions and social insurance.

Table 3: Scale and meaning of pairwise judgment matrix

Q_i factor compared with Q_j factor (Q_i/Q_j)	*Quantized value q_{ij}*
Q_i is as important as Q_j	1
Q_i is slightly more important than Q_j	3
Q_i is more important than Q_j	5
Q_i is more important than Q_j	7
Q_i is extremely important than Q_j	9
Q_i is more important than Q_j as the median value of two adjacent judgments	2,4,6,8
The opposite of the importance of Q_i and Q_j	Q_j /Q_i=1÷Q_i/ Q_j

Table 4: Value of the average random consistency index RI

n	1	2	3	4	5	6	7	8	9	10	…
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49	…

Table 5: Evaluation index system and weight of employment quality of university graduates

Target layer	*Criteria layer (weight)*	*Indicator layer (weight)*
Employment quality of college graduates	Employment effect(47.87%)	Matching work and major(10.95%)
		Current job is stable(30.90%)
		Satisfied with your job(58.16%)
	Work benefits(17.16%)	Satisfied with your salary level(69.23%)
		Satisfied with your chance to raise your salary(23.08%)
		Satisfied with the company accommodation arrangement(7.69%)
	Work environment(8.90%)	Reasonable working hours(11.12%)
		Low working pressure(46.99%)
		Low working intensity(27.61%)
		Comfortable office environment(3.18%)
		Get along well with colleagues(11.12%)
	Social insurance(8.90%)	The company pays five social insurance and one housing fund(57.14%)
		Satisfied with the company's insurance base(28.57%)
		Satisfied with company supplementary insurance(14.29%)
	Career Development(17.16%)	Satisfied with the job training of the company(10.95%)
		Current job prospects are good(30.90%)
		Satisfied with your promotion opportunity(58.16%)

2.2.4 Establishment of AHP-BP neural network model

BP (Back Propagation) neural network is currently the most widely used neural network. The entire learning process consists of forward propagation of information data and back propagation of error data. The input information data is transmitted from the input layer to the hidden layer. The hidden layer processes the data, and can be designed into a single hidden layer and multiple hidden layers structure, and finally output in the output layer [4]. When the data in the output layer does not match the actual value, the error propagates back, and the network modifies the weights of neurons in each layer so that the error signal reaches the minimum value. The process of neural network learning is the process of forward propagation of information data and back propagation of errors. The network reaches the preset learning times or the output error is reduced to the set requirements, and the learning process ends [5].

(1) Determine the number of input and output nodes of the neural network model

The number n of nodes in the input layer of the BP neural network model is the same as the number of evaluation indicators in the index layer, which is 17. The output is the evaluation value of the employment quality of university graduates, so the number of nodes in the output layer m = 1.

(2) Determine the number of hidden layer nodes of the neural network model

The number of hidden layer nodes is relatively complicated. So far, there is no unified algorithm, and the formula for determining more hidden layer nodes is as follows:

$$b = \sqrt{n + m} + a$$

In the above formula, b is the number of nodes in the hidden layer, n is the number of nodes in the input layer, m is the number of nodes in the output layer, a is a constant between 1 and 10, and combined with the test results, n is set to 8 [6].

(3) Determine training samples and test samples

The first 335 data of 375 questionnaires are selected as the training set, and the remaining 40 data are the test set. Then create a BP neural network through R software (as shown in Figure 1), and conduct training and testing [7].

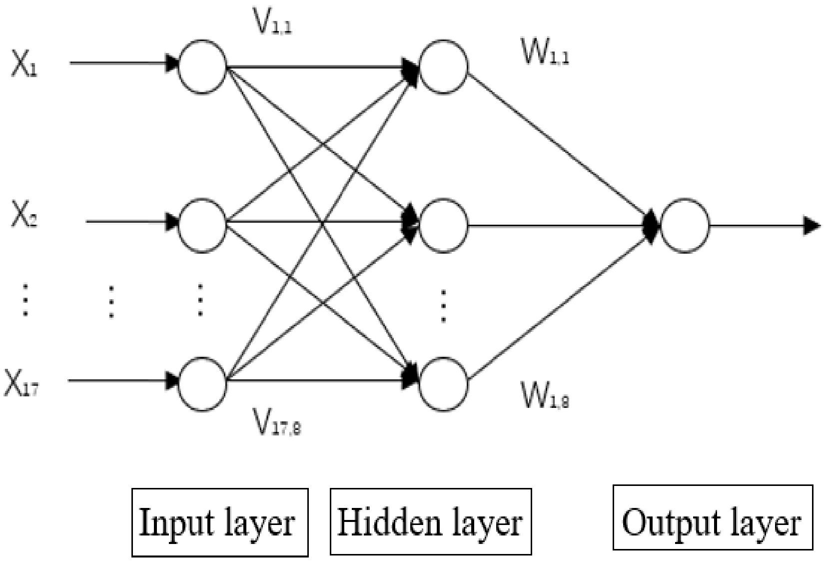

Figure 1: BP neural network structure diagram

(4) Parameter setting of neural network model

Select "newff" for the training function, learning.rate.global is set to "1e-2", momentum.global is set to "0.5", error.criterium is set to "LMS", Stao is set to "NA", hidden.layer is set to "tansig", output.layer is set to "purelin", method is set to "ADAPTgdwm" [8].

Table 6: Test results of BP neural network

Numbering	1	2	3	4	5	6	7	8
Expected value	4.022	4.022	4.863	4.582	4.542	4.542	1.767	1.000
output value	4.022	4.022	4.868	4.579	4.547	4.547	1.766	1.001
Relative error (%)	-0.017	-0.017	0.101	-0.070	0.116	0.116	-0.058	0.116
Numbering	9	10	11	12	13	14	15	16
Expected value	4.022	2.329	4.923	1.000	4.542	4.923	1.767	4.863
output value	4.022	2.328	4.915	1.001	4.547	4.915	1.766	4.868
Relative error (%)	-0.017	-0.054	-0.166	0.116	0.116	-0.166	-0.058	0.101

Numbering	17	18	19	20	21	22	23	24
Expected value	4.582	4.863	4.022	4.542	2.208	3.441	2.208	2.774
output value	4.579	4.868	4.022	4.547	2.207	3.441	2.207	2.776
Relative error (%)	-0.070	0.101	-0.017	0.116	-0.042	-0.008	-0.042	0.072
Numbering	25	26	27	28	29	30	31	32
Expected value	4.582	1.000	4.542	4.542	2.208	4.022	4.022	2.329
output value	4.579	1.001	4.547	4.547	2.207	4.022	4.022	2.328
Relative error (%)	-0.070	0.116	0.116	0.116	-0.042	-0.017	-0.017	-0.054
Numbering	33	34	35	36	37	38	39	40
Expected value	4.848	1.767	4.582	4.923	4.542	1.767	3.441	2.774
output value	4.849	1.766	4.579	4.915	4.547	1.766	3.441	2.776
Relative error (%)	0.017	-0.058	-0.070	-0.166	0.116	-0.058	-0.008	0.072

(5) Test results

The test results of the established BP neural network model on 40 test samples are shown in Table 6. It can be seen that the relative error between the output value of the training result and the expected value obtained by the BP neural network model is very small, and the maximum relative error is 0.00116. The established neural network evaluation model of college student employment quality has good effect and small error. When evaluating the employment quality of college students in the future, the evaluation result can be obtained by starting the network.

3. Results of empirical analysis

Considering that the questionnaire was designed using Likert scale, 1 means "strongly disagree", 2 means "disagree", 3 means "average", 4 means "agree" and 5 means "strongly agree". The employment quality evaluation value of university graduates obtained by using AHP-BP model is divided into two parts. When the evaluation value is greater than or equal to 3, it is defined as "high employment quality"; when the evaluation value is less than 3, it is defined as "low employment quality".

Table 7: Analysis on the degree of satisfaction of graduates with different employment quality to the teaching practice courses offered in school

		The degree of satisfaction with the teaching practice courses offered at school					χ^2	*p*
		strongly disagree	*disagree*	*average*	*agree*	*strongly agree*		
Low quality of employment	count	14	10	68	51	8	35.032	0.000
	proportion %	9.3%	6.6%	45.0%	33.8%	5.3%		
High quality of employment	count	39	60	63	55	7		
	proportion %	17.4%	26.8%	28.1%	24.6%	3.1%		

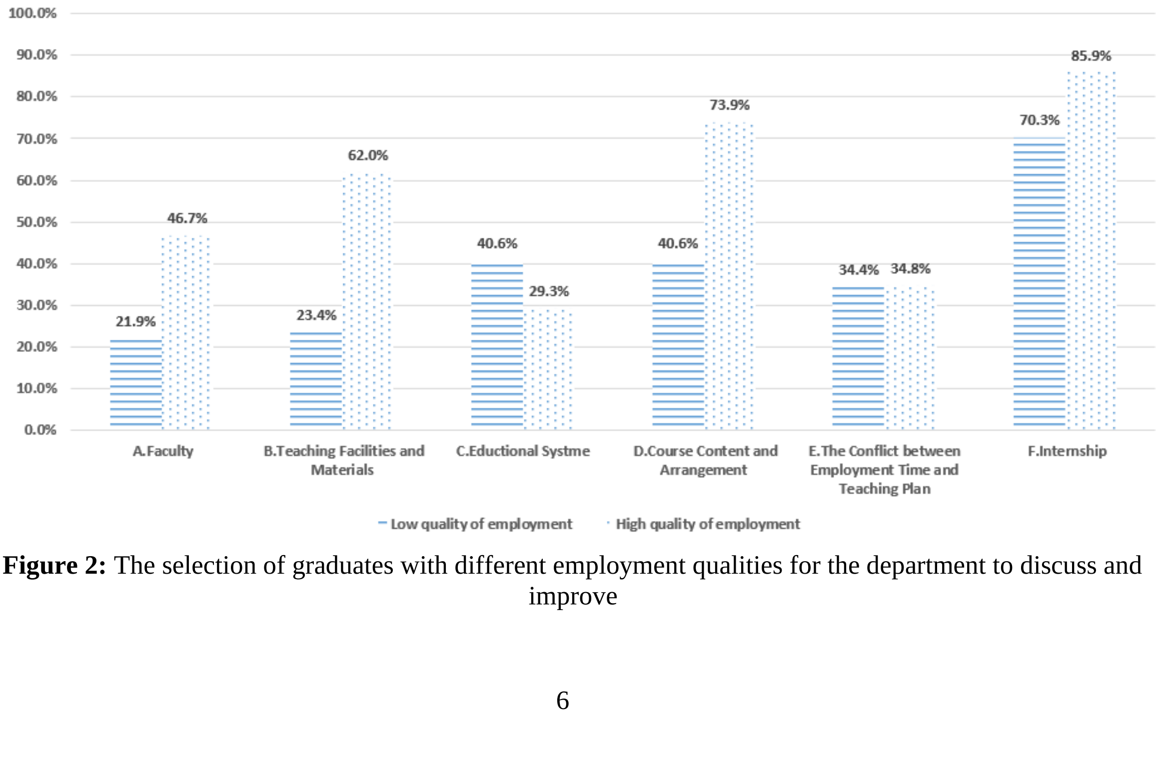

Figure 2: The selection of graduates with different employment qualities for the department to discuss and improve

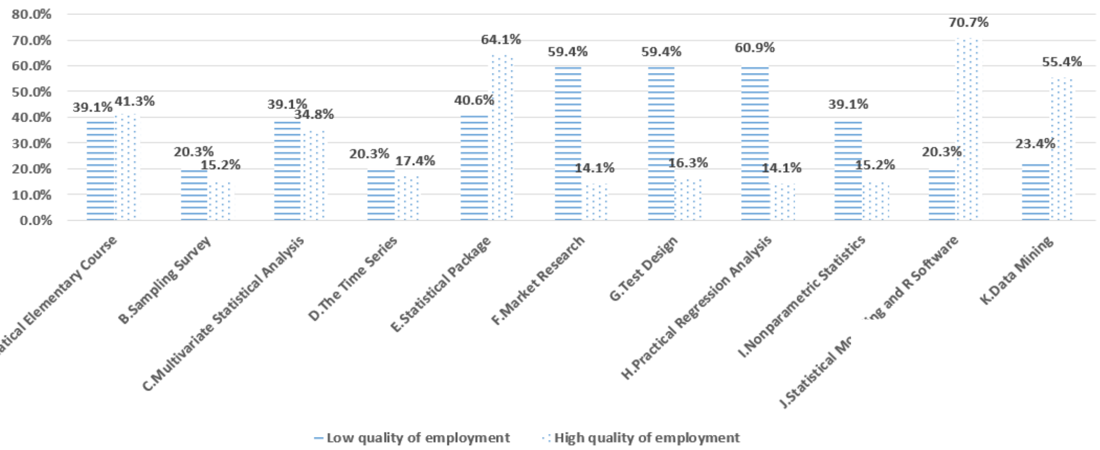

Figure 3: The selection of graduates with different employment qualities who should master the most professional courses

There was a significant difference in the satisfaction degree of graduates with different employment quality to the teaching practice courses offered during the school period (χ^2 =35.032, P=0.000<0.05), and the satisfaction degree of graduates with high employment quality to the teaching practice courses offered during the school period was significantly lower than that of graduates with low employment quality.

High-employment quality graduates are more inclined to choose the faculty to be worth discussing and improving, and 46.7% of the high-employment quality graduates are worth the faculty to discuss and improve. High-employment quality graduates are more inclined to choose teaching facilities and teaching materials that are worthy of discussion and improvement by the department. 62.0% of high-employment quality graduates choose teaching facilities and teaching materials that are worthy of discussion and improvement by the department. High-employment quality graduates are more inclined to choose professional course content and arrangements that are worthy of discussion and improvement by the department. 73.9% of high-employment quality graduates choose professional course content and arrangements that are worthy of discussion and improvement by the department.

High-quality graduates are more inclined to choose courses in software applications. 70.7% of high-employment quality graduates should choose statistical modeling and R software courses, 55.4% of high-employment quality graduates should choose data mining courses, 64.1% of high-employment quality graduates should choose statistical software Package courses.

4. Conclusion and Discussion

Statistics graduates are less satisfied with the teaching practice courses offered during school, among which the graduates with high employment quality are significantly less satisfied with the teaching practice courses than the graduates with low employment quality. It shows that statistics professional teaching practice course in our school can't meet the employment needs of statistical professional students, especially can't meet the high employment quality of the graduates. The vast majority of graduates believe that faculties should improve their internships. It is believed that the number of high-employment quality graduates who need to be improved in terms of faculty, teaching facilities, teaching materials, professional course content and arrangements is significantly more than the number of low-employment quality graduates. Further research has found that graduates with high employment quality are more focused on choosing courses that have a wide range of practical applications such as statistical analysis software and data mining.

In response to the above problems, three measures for the reconstruction of the practical teaching system of applied statistics in our school are proposed:

4.1 Optimize the Teaching Structure of Statistics Majors

Strengthen the training of statistics professional practice teachers. The school creates conditions for practical teachers to participate in high-level academic exchange meetings, and encourages practical teachers to go to famous universities or enterprises for academic exchanges or training. Further strengthen the school-enterprise cooperation, deepen the integration of production, teaching and research, cultivate "dual-teacher" teachers, and gradually form a reasonable teacher structure for the simultaneous development of theoretical and practical teaching teachers [9].

Enterprise managers and government officials with rich practical experience are employed as social mentors to guide students in practical teaching courses.

4.2 Adjust the Curriculum System of Statistics Major

Following the "OBE" talent training concept, with the emphasis on strengthening practice and highlighting applications, and with the goal of enhancing students' ability to integrate theory with practice, the statistical major curriculum system was adjusted. Add C language programming courses to basic courses to strengthen students' understanding of basic programming language methods, procedures and logic. The basic courses add database principles and technologies to strengthen students' ability to process dynamic interactive information. Specialized elective courses add basic artificial intelligence tutorials and Hadoop basic tutorials to strengthen students' ability to build and analyze artificial intelligence and big data frameworks [10].

4.3 Improve the Practice Teaching System of Statistics

According to the law of learning and cognition, build a progressive three-level model practical teaching system: case embedding, project-driven, school-enterprise collaboration, to achieve a "zero distance" between talent training and the actual needs of the industry, and adopt "order-style" talent training. Introducing excellent cases as an important course content into practical teaching can enable students to use the knowledge they have learned to solve problems and help students deepen their understanding and mastery of knowledge [11].

Encourage students to participate in college students' innovation and entrepreneurship projects, encourage students to participate in scientific research projects of statistics teachers, and encourage students to participate in social survey activities on holidays. By participating in these practical activities, not only can the students' analytical and practical skills be strengthened, but also their teamwork and communication skills can be strengthened [12]. Innovate the collaboration between schools and enterprises, improve the integration of industry and education, promote the deep participation of industry enterprises in the training process, and strengthen the cultivation of students' practical and innovative capabilities [13].

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