Quality evaluation of practical training of innovative and entrepreneurial talents in universities based on statistical learning theory after COVID-19 epidemic

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Abstract. During the COVID-19 epidemic, college students could not return to the school, which had a great impact on the talent training of colleges and universities. Based on the statistical learning theory, this paper puts forward an evaluation model for the cultivation of innovative talents in universities after the epidemic. In this paper, the evaluation index system of the quality of innovative and entrepreneurial personnel training in Universities, which is composed of four first-class indexes: environment, teaching links, teachers and students, is constructed. At the same time, this paper uses the fuzzy comprehensive evaluation method for empirical research. Firstly, the factor set of the evaluation object and the grade domain of the comprehensive evaluation are determined. Then, AHP is used to determine the weight of evaluation indexes and expert scoring method is used to determine the single factor fuzzy comprehensive evaluation matrix of each level. According to the evaluation matrix, the fuzzy relation between evaluation object and evaluation set is calculated. Finally, according to the principle of maximum membership degree, the evaluation grade corresponding to the maximum value in the fuzzy relation set is calculated as the evaluation result of the final evaluation object. The empirical results show that this method can improve the accuracy of the evaluation model of innovation and entrepreneurship talent training, and has a certain reference value for the talent training in Universities.

Keywords: Fuzzy set, statistical learning theory, single factor fuzzy comprehensive evaluation matrix, talent training

1. Introduction

Since December 2019, Wuhan City, Hubei Province has continued to carry out surveillance of influenza and related diseases, and found multiple cases of viral pneumonia, all diagnosed with viral pneumonia/pulmonary infection [1].

Health and anti-epidemic experts emphasized that the main transmission routes of new coronary pneu-monia are direct transmission, aerosol transmission and contact transmission. Therefore, the government has introduced personnel control measures in response to the spread of new coronary pneumonia [2, 3]. During the epidemic, college students could not return to the school, which had a great impact on the talent training. Based on the statistical learning theory, this paper puts forward an evaluation model for the cultivation in universities after the epidemic [4].

The core of this opinion is to further deepen the comprehensive reform of entrepreneurship and employment of college graduates [5, 6]. Innovation

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and Entrepreneurship (I&E) education is education first. In the final analysis, we should cultivate talents. It should further strengthen the education of ideals and beliefs and strive to enhance students' innovative spirit, entrepreneurial awareness and I&E ability. The potential of each student should be stimulate to a greater extent. We should promote closer integration of I&E education with professional education. The students should be stimulate to consolidate their professional knowledge in I&E and improve the ability of I&E in professional education. For the high-quality development of economy and society, it should cultivate a large number of high-quality talents who are bold and innovative. To improve the quality of College Students' training is also the responsibility of colleges and universities [7–9]. This paper will build an evaluation index system to evaluate the quality of I&E talents training in Colleges and universities according to the existing research results and the situation of I&E talents training in our university.

2. Index system of quality evaluation of innovative and entrepreneurial talents training

2.1. The connotation of innovative and entrepreneurial talents

There is no consensus on the definition of innovative and entrepreneurial talents. At present, there are two views on the definition of innovative and entrepreneurial talents: one is that "innovative and entrepreneurial talents refer to talents with the ability of creation, I&E.". Second, the innovative and entrepreneurial talents mainly refer to the talents with innovative spirit, entrepreneurial consciousness, entrepreneurial thinking, learning ability and innovative and entrepreneurial ability.

Combined with the above two points of view, the innovative and entrepreneurial talents studied in this paper mainly refer to the compound talents including both innovative quality and entrepreneurial potential. Such talents have the consciousness, ability, psychological quality and comprehensive knowledge of I&E at the same time. The innovative and entrepreneurial talents in Colleges and universities are the talents who have innovative thinking, innovative consciousness and the ability to use their own innovative skills to create a cause.

Entrepreneurial talents need to have innovative thinking and ability, and innovative talents need to

have the quality of entrepreneurs. The innovative and entrepreneurial talents in Colleges and universities should have unique innovative thinking, which is sensitive, easy to spread, good at association and flexibility [10]. In addition, innovative and entrepreneurial talents in Colleges and universities will put their ideas into practice, actively participate in various competitions, and improve their I&E ability [11–15].

2.2. Index system

I&E education in Colleges and universities is a systematic project involving government, society, schools and other departments. It involves education and teaching, practice platform, teaching staff, social support and other aspects. Therefore, we should consider the scientificity, comprehensiveness, feasibility and operability of the index when selecting the evaluation index. The index system can reflect the ability and potential of college students. The index system of the quality evaluation of I&E talents training in Colleges and universities constructed in this paper includes four first-class indexes, such as college environment, teaching links, teachers and students evaluation. Among them, the university environment includes 6 secondary indicators, such as the number of I&E centers, the coverage rate of funding support for students in incubation parks, the coverage rate of students in I&E projects of college students, and the conversion rate of innovation achievements. The teaching links include 5 secondary indicators, such as the number of hours of I&E courses, the participation rate of students in practical courses, and the opening rate of interdisciplinary courses. The teaching staff includes 8 secondary indicators, including the proportion of teachers with entrepreneurial experience, the proportion of teachers with entrepreneurial and business management training experience, and the proportion of teachers with high academic qualifications. Student evaluation includes 8 secondary indicators, including the proportion of part-time students, the number of published papers, the number of subjects involved, the number of patents for inventions, and the number of social practices involved. The specific index system is shown in Table 1.

2.3. Fuzzy comprehensive evaluation method

The fuzzy comprehensive evaluation method is a method which uses the membership degree theory of fuzzy mathematics to change the qualitative evalua-

Table 1
Quality evaluation index system of innovative and entrepreneurial talents training in Universities

Index system(A)	College environment (B1)	Number of I&E competitions (C1)
		Number of symposiums held (C2)
		Student coverage of I&E projects for college students (C3)
		Number of I&E centers (C4)
		Coverage rate of financial support of Incubation Park for students (C5)
	Teaching link (B2)	Transformation rate of innovation achievements (C6)
		Hours of I&E (C7)
		Student participation rate of I&E course (C8)
		Participation rate of students in practical courses (C9)
		Opening rate of interdisciplinary courses (C10)
		Penetration of entrepreneurial knowledge in existing courses (C11)
	Faculty (B3)	Proportion of teachers with entrepreneurial experience (C12)
		Proportion of teachers with entrepreneurial and business management training experience (C13)
		Proportion of highly educated teachers (C14)
		Proportion of persons with senior professional titles (C15)
		Proportion of transformation of innovative achievements (C16)
		Number of teachers on probation (C17)
		Theoretical achievements of I&E Education published (C18)
		Number of times of teachers participating in social industry I&E practice (C19)
	Student evaluation (B4)	Proportion of part-time students (C20)
		Proportion of students in family business (C21)
		Proportion of students with relevant training experience (C22)
		Number of papers published (C23)
		Number of subjects involved (C24)
		Number of social practices (C25)
		Number of patents for invention (C26)
		Number of entrepreneurial practices (C27)

tion into the quantitative evaluation. This method can make an overall evaluation of the things or objects involving multiple factors. Generally, this method is suitable for solving some uncertain problems. The operation steps of this evaluation method: first, determine the factor set of the evaluation object. Then we should determine the rank domain s of comprehensive evaluation. The weight V of evaluation index is determined by AHP. The single factor fuzzy comprehensive evaluation matrix R of each level is determined by expert scoring method. Then the fuzzy relation W ($W = v*r$) between the evaluation object and the evaluation set is calculated. Finally, according to the principle of maximum membership, the evaluation grade corresponding to the maximum value in W is calculated as the evaluation result of the final evaluation object.

3. Empirical research

3.1. Construction of evaluation index system

According to the above content, the evaluation index system is constructed, including four first-class

indexes, such as university environment, teaching link, faculty and student evaluation. It also includes 27 secondary indicators such as the number of I&E competitions and the number of special seminars etc.

3.2. Determination of evaluation index weight

The weight of evaluation index is calculated by AHP software. By organizing the experts from the recruitment and employment department, the students' department and the teaching units to rate the proportion of various factors in the quality index system of innovative and entrepreneurial talents training in our school. After multiple rounds of scoring, the weight of each indicator factor is calculated as shown in Table 2–6 below.

3.3. Fuzzy comprehensive evaluation

Our university is taken as the evaluation object, and makes a comprehensive evaluation on the quality of its innovative and entrepreneurial talents training. Suppose that S_i (i = 1, 2, 3, 4, 5) represents the quality of innovative and entrepreneurial personnel training in Colleges and universities, and S_1, S_2, S_3, S_4, S_5

Table 2
Weight of first level index

A	College environment (B1)	Teaching link (B2)	Faculty (B3)	Student evaluation (B4)	Wi (weight)
College environment (B1)	1	0.5	0.5	1	0.195
Teaching link (B2)	2	1	0.5	2	0.276
Faculty (B3)	2	2	1	2	0.391
Student evaluation (B4)	0.5	0.5	0.5	1	0.138

Table 3
Weight of B1-C

B1	C1	C2	C3	C4	C5	C6	Wi
C1	1	1	1	0.5	0.5	0.5	0.111
C2	1	1	0.5	0.5	0.5	0.5	0.099
C3	1	2	1	1	1	0.5	0.157
C4	2	2	1	1	0.5	0.5	0.157
C5	2	2	1	2	1	0.5	0.197
C6	2	2	2	2	2	1	0.279

Table 4
Weight of B2-C

B2	C7	C8	C9	C10	C11l	Wi
C7	1	0.5	1	2	0.5	0.161
C8	2	1	2	2	0.333	0.224
C9	1	0.5	1	2	0.5	0.161
C10	0.5	0.5	0.5	1	0.5	0.106
C11	2	3	2	2	1	0.348

Table 5
Weight of B3-C

B3	C12	C13	C14	C15	C16	C17	C18	C19	Wi
C12	1	2	3	2	1	2	2	2	0.199
C13	0.5	1	2	2	0.333	0.5	0.5	0.5	0.083
C14	0.333	0.5	1	0.5	0.333	0.5	0.5	0.5	0.055
C15	0.5	0.5	2	1	0.5	0.5	0.5	0.5	0.073
C16	1	3	3	2	1	2	3	3	0.232
C17	0.5	2	2	2	0.5	1	1	1	0.123
C18	0.5	2	2	2	0.333	1	1	0.5	0.108
C19	0.5	2	2	2	0.333	1	2	1	0.127

Table 6
Weight of B4-C

B4	C20	C21	C22	C23	C24	C25	C26	C27	Wi
C20	1	0.333	0.5	2	2	0.5	0.333	0.5	0.076
C21	3	1	2	4	4	2	1	2	0.229
C22	2	0.5	1	2	2	1	0.333	0.5	0.103
C23	0.5	0.25	0.5	1	1	0.5	0.333	0.5	0.056
C24	0.5	0.25	0.5	1	1	0.5	0.333	0.5	0.056
C25	2	0.5	1	2	2	1	0.333	0.5	0.103
C26	3	1	3	3	3	3	1	2	0.236
C27	2	0.5	2	2	2	2	0.5	1	0.141

respectively represent five levels: poor, poor, general, good and good. 10 school experts are employed to grade all factors of the training quality of innovative and entrepreneurial talents, and then sort out the evaluation data to get the fuzzy relationship matrix of all factors.

The university environment is taken as an example, the fuzzy matrix R_1 of index B_1 is obtained through fuzzy statistical calculation:

$$R_1 = \begin{bmatrix} 0.4 & 0.3 & 0.3 & 0 & 0 \\ 0.6 & 0.4 & 0 & 0 & 0 \\ 0.3 & 0 & 0.3 & 0.4 & 0 \\ 0.2 & 0.7 & 0.1 & 0 & 0 \\ 0.2 & 0.7 & 0.2 & 0 & 0 \\ 0.1 & 0.8 & 0.1 & 0 & 0 \end{bmatrix}$$

The weight of each index of university environment is V_1.

$$V_1 = \begin{bmatrix} 0.111 & 0.099 & 0.157 \\ 0.157 & 0.197 & 0.279 \end{bmatrix}$$

Then the comprehensive evaluation results (W_1) of university environment are shown as follows:

$$W_1 = V_1 \times R_1 =$$

$$\begin{bmatrix} 0.348 & 0.425 & 0.164 & 0.063 & 0 \end{bmatrix}$$

In the same way, the comprehensive evaluation results of teaching links, teachers and students can be calculated, which are W_2, W_3 and W_4 respectively.

$$W_2 = V_2 \times R_2 =$$

$$\begin{bmatrix} 0.022 & 0.419 & 0.244 & 0.186 & 0.129 \end{bmatrix}$$

$$W_3 = V_3 \times R_3 =$$

$$\begin{bmatrix} 0 & 0.217 & 0.411 & 0.267 & 0.105 \end{bmatrix}$$

$$W_4 = V_4 \times R_4 =$$

$$\begin{bmatrix} 0.038 & 0.209 & 0.327 & 0.250 & 0.176 \end{bmatrix}$$

According to the principle of maximum subordination degree of fuzzy comprehensive evaluation method, we can see that the current quality of I&E talents training in Colleges and universities is low, and this evaluation result is consistent with the reality. Through the fuzzy evaluation of the environment, teaching links, teachers and students, it is found that the comprehensive evaluation results of the university environment are poor. Especially in the transformation rate of innovation achievements and the number of I&E centers. The result of comprehensive evaluation in teaching is also poor, which is mainly reflected in the low penetration of entrepreneurial knowledge in existing courses and the low opening rate of interdisciplinary courses. The results of the comprehensive evaluation of the teaching staff are general. Because the number of university teachers who have entrepreneurial experience is less, and the proportion of teachers' innovation achievement transformation is lower. In the aspect of student evaluation, the comprehensive evaluation results are general, mainly because the number of patents invented by students and the number of entrepreneurial practices participated by students are low.

4. Suggestions on the cultivation of innovative and entrepreneurial talents in universities

4.1. Implementation path of training innovative and entrepreneurial talents in universities

Innovation is the soul of University, and entrepreneurship is the social responsibility of University. The applied undergraduate course is closely related to local economic and social development, and industry. The relationship between I&E education and professional quality education should be well handled in the training of I&E talents. Starting from the reality of the region where the school is located, this paper explores the formation of innovative and entrepreneurial education mode with its own characteristics and openness.

(1) The support of local government should be sought to construct a rational division of labor and a benign interaction mechanism of university I&E education. The government should strengthen the construction of I&E training and support system to make up for the lack of educational power and funds in Colleges and universities. The government gives preferential policies in industrial and commercial registration, financial support, tax relief, office buildings and other aspects to encourage college students to start their own businesses. The government should promote the construction of College Students' entrepreneurship Park and provide a platform for college students'

entrepreneurship practice. Enterprises should actively undertake social responsibilities, act as entrepreneurial mentors, and participate in entrepreneurial guidance and services. Colleges and universities should actively promote the reform and innovation of education and teaching mode, and play the role of all courses and practical links.

(2) Industrial advantages should be used to build a "big classroom" of I&E education. We should combine classroom teaching with extracurricular activities, school teaching with off campus practice. From the aspects of creative consciousness, spirit, personality, knowledge and ability, the course teaching should be arranged reasonably. We should cooperate with enterprises in the construction of practice training base, so that students can understand the management and operation of enterprises on the spot. Students should take the initiative to understand the industry's profit model and various knowledge and skills required for entrepreneurship. The enterprise mentoring system should be established to let the enterprise mentors with entrepreneurial experience and management experience participate in the guidance and training of entrepreneurial projects. We should cooperate with enterprises and actually participate in product research and development, management innovation, market development, etc.

(3) I&E education should serve local economic and social development, and create a variety of I&E education platforms. Students should be organized to participate in Teachers' scientific research projects so that they can understand the characteristics and development trends of enterprises, industries and regions, so as to improve students' abilities in investigation and analysis, inductive reasoning, knowledge innovation, etc. Business mentors should actively participate in the guidance of the business plan, so that the business plan is closer to the market and the actual operation of the enterprise. Excellent projects should be chosen to give financial support, so that students' entrepreneurial teams can truly operate and gain entrepreneurial experience. For projects that can be commercialized, enterprises and governments should provide support to form a brand for students to start their own businesses.

Schools should broaden their horizons and effectively carry out international I&E education cooperation. International cooperation in academic research, curriculum development and textbook publishing should be carried out to improve the level of I&E education. Students should be encouraged to participate in international I&E Program competitions. Through competition, let students and teachers communicate with foreign universities, experience the I&E culture of different countries, and learn from each other. We should cooperate with multinational companies to put forward solutions to the problems of technology research and development, product development, market and brand development that enterprises are concerned about, so as to improve the ability to solve practical problems.

4.2. Suggestions on training innovative and entrepreneurial talents in universities

(1) Creating a good environment for innovation in Universities

In order to improve the I&E ability of college students, the school should increase investment in software and hardware environment. From the aspect of hardware, we can add more laboratories of I&E center, so that more students of different majors can enter the laboratory to participate in I&E activities. From the aspect of software, the school should regularly hold special seminars on I&E, and employ CEOs of some enterprises to introduce ideas and methods of I&E to students. In addition, the university should increase the investment in the Incubation Park and improve the support coverage rate of the Incubation Park for the entrepreneurial funds of college students.

(2) Improving the quality of I&E teaching

The core of College Students' I&E ability is to improve the quality of I&E teaching. Colleges and universities should increase the popularity of I&E courses, so that students of all specialties in schools should participate in the study of I&E courses. Schools should also increase the opening rate of interdisciplinary courses, expand the field of students' learning, and integrate the awareness of I&E into the learning process of existing professional courses.

(3) Actively cultivating "Elite Teacher"

On the one hand, colleges and universities should introduce more teachers with entrepreneurial experience, on the other hand, they should carry out entrepreneurship training for teachers in the school, and cultivate teachers with "double qualification". In addition, the school should send more excellent

teachers to join the company for training, improve the practical ability of teachers, and encourage teachers to participate in the practice of I&E in the social industry.

(4) Encouraging students to actively participate in all kinds of I&E activities.

On the one hand, college students should be guided to actively participate in the research of teachers' projects and to enable students to grasp the cutting-edge knowledge and development trends of this project in time by participating in the project. On the other hand, students should be encouraged to actively participate in social practice. It should improve students' practical ability through social practice activities and lay a solid foundation for future I&E.

5. Conclusions

The I&E education reform of college students is imminent. How to improve the quality of I&E talents training is an urgent problem to be solved in Colleges and universities. On the basis of defining the connotation of innovative and entrepreneurial talents, this paper constructs a quality evaluation index system of innovative and entrepreneurial talents training in Colleges and universities, which is composed of four first-class indexes, i.e. university environment, teaching links, teachers and students.

At the same time, this paper uses the fuzzy comprehensive evaluation method for empirical research. According to the evaluation results, the paper puts forward the countermeasures to improve the quality of I&E talents training in universities from the four aspects, i.e. creating a good innovation environment; improving the quality of I&E teaching; cultivating the elite teachers of I&E and encouraging students to actively participate in various I&E activities.

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