BP neural network study on the quality evaluation system of innovation and entrepreneurship education in local universities

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Abstract. When the country vigorously advocates the goal of cultivating innovative and entrepreneurial engineering talents, the quality evaluation of innovation and entrepreneurship education has naturally become a part of the higher education system. However, there are few studies on the quality evaluation of innovation and entrepreneurship education in engineering majors in China. Firstly, through literature research, combined with the current development trend of quality evaluation of innovation and entrepreneurship education at home and abroad, BP neural network-based evaluation method was selected. Secondly, according to the three-element theory of education, namely, the three factors of educators, educators and education, and comprehensive research, the content of quality evaluation of innovation and entrepreneurship education in engineering majors in colleges and universities is determined, that is, from professional links, teaching links and students. Levels to build evaluation indicators. After establishing the evaluation index system, this paper uses Chengdu University of Technology as a research sample to issue questionnaires for engineering students in Chengdu University of Technology to obtain data for use, and to analyze and analyze the data by AHP, so as to obtain the weight of each indicator. Finally, based on the data collected by the questionnaire, the BP neural network data fitting and model training and optimization are carried out to determine the feasibility of the quality evaluation index of innovation and entrepreneurship education in engineering majors in colleges and universities, and to establish BP neural network evaluation model for engineering majors. The innovation and entrepreneurship education quality evaluation system provides new research methods and research ideas, enriches the connotation and breadth of the quality evaluation system of innovation and entrepreneurship education in engineering majors, and makes up for the shortcomings and vacancies in related fields.

1. Introduction
With the implementation of the national strategy of innovation and entrepreneurship driven development, the cultivation mode of university talents has also undergone significant changes. In April 2002, the pilot work symposium on entrepreneurship education in national ordinary universities held by the ministry of education indicated for the first time that innovation and entrepreneurship education should focus on the process and the cultivation of comprehensive quality of innovation and entrepreneurship, and put forward that innovation and entrepreneurship education is a concept [1]. The
13th five-year plan and the report of the 19th national congress of the communist party of China also put forward the call to "stimulate the vitality of innovation and entrepreneurship, promote mass entrepreneurship and innovation" and "stimulate and protect entrepreneurship, and encourage more social subjects to engage in innovation and entrepreneurship" [2]. In addition, a series of policy documents issued by the General Office of the CPC Central Committee and The State Council, as well as conferences and speeches on related topics, have pushed the wave of innovation and entrepreneurship to the forefront of The Times, and innovation and entrepreneurship education in colleges and universities has attracted much attention.

In 1945, scholars in Harvard University proposed that the joint cultivation of students' knowledge and innovation ability should be emphasized. The educational philosophy of the universities of Cambridge and Oxford in Britain is to "explore, explore and develop students' potential ability and stimulate individual creativity", which shows the importance of innovation and entrepreneurship education [4]. In the national defense education act of 1958, the U.S. government proposed to enhance international competitiveness by enhancing innovative education [5]. In 1981, "besson entrepreneurship annual conference" was successively held by American Besson College, university of Washington and other universities [6]. In 1989, UNESCO held "international seminar on education for the 21st century", which pointed out that entrepreneurship education should focus on cultivating students' pioneering ability and innovative spirit [7]. In 2010, the European Union stated in its education report that to strengthen the reform of entrepreneurship education, it is necessary to develop entrepreneurship education with an open and cooperative attitude, encourage member states to continue to formulate special entrepreneurship education development strategies, and encourage cooperation between schools and enterprises in the field of entrepreneurship education [8]. By 2017, nearly 2,000 colleges and universities in the United States have set up courses related to innovation and entrepreneurship education, including primary, high school, university and postgraduate education, and formed a relatively complete education and teaching system. More than 75% of colleges and universities in the United Kingdom have set up courses related to innovation and entrepreneurship education [9]. In addition, in Australia, innovation, entrepreneurship education teaching faculty got the high attention, innovative entrepreneurship education instructor is mostly entrepreneurs with higher education, they have professional theoretical foundation and rich experience in actual combat, in other developed countries such as Japan, Singapore, innovation, entrepreneurship education has also been incorporated into the education system in [10].

Relevant scholars, experts, researchers mostly committed to innovative entrepreneurship, method, model of research and analysis, evaluate the quality of college engineering specialty innovative entrepreneurship education is little, so to establish a set of perfect innovation entrepreneurship education quality evaluation system to help the engineering innovation business of development become the urgent needs of quality education, this paper adopts literature analysis, questionnaire investigation, literature analysis, using the method of BP neural network model for the main business innovation education quality evaluation for engineering majors, attempt to establish a more mature about college engineering specialty innovative entrepreneurship education quality evaluation system. This will have certain theoretical and practical significance for the development and optimization of innovation and entrepreneurship education in China.

2. Material and method

2.1. Research method

2.1.1. Literature analysis

Through resources such as cnki.com and the library of Chengdu University of technology, we have an in-depth understanding of the progress of innovation and entrepreneurship education at home and abroad and the relevant evaluation system, and summarize the advantages and disadvantages of innovation and entrepreneurship education in Chinese universities.
2.1.2. Questionnaire survey.
Based on the index system of engineering major extracted from Chengdu University of technology, I consulted relevant experts and tutors on campus, prepared questionnaires, conducted surveys on engineering majors, and obtained a real and effective data, so as to determine the weight coefficient of each index.

2.1.3. Empirical analysis
After determine evaluation model, with Chengdu university of technology as case study for the engineering specialty, and for engineering specialty, to calculate weight of the technical indicators related and validity, etc., it is concluded that the Chengdu university of science and engineering professional business innovation in all aspects of the education quality, to analyze the evaluation results, find out the insufficiency, through the empirical study proves the practicability of this study.

2.1.4. BP neural network method.
Compared with traditional data analysis methods, BP neural network has high data adaptability and can be applied to a variety of data types. By improving the BP neural network model, the disadvantages of poor and slow convergence rate can be overcome, so that the model can describe parameter relations and obtain better evaluation results.

2.2. Construction of evaluation index
On the establishment of the quality evaluation index of innovation and entrepreneurship education, Guo Xiaofang and others believe that the quality evaluation of innovation and entrepreneurship education should be composed from the macro level, the teacher level, the student level and the educational environment and form [11]. Zhang Xinze believes that the quality evaluation of innovation and entrepreneurship education is influenced by college environment, teaching design, faculty strength and student performance [12]. Xu hui believes that the quality of innovation and entrepreneurship education is influenced by theoretical knowledge, practical skills, innovative consciousness and creative thinking industry [13]. Gaoming et al. found in their research that innovation and entrepreneurship education should be carried out from the school level, the teacher level, the family level and the social level. Research combined with the level of the teachers and students have mentioned above, the teachers level, this article also think teachers for education in the three elements of the body of the educators, has the leading role, the teachers level is much higher than other factors, the influence of the same, students as the principal part of education according to the elements of the students to innovative entrepreneurship education reflect the effect of the quality of the creative education, the role of this level is also cannot be ignored, in addition, the research of engineering professional, should be mainly focused on the characteristics of the profession itself, as the center, to make the results of the study have credibility, so combining with the practical engineering profession in university, This research will construct the quality evaluation system of innovation and entrepreneurship education for engineering majors in local universities from three aspects: teaching link, professional link and student level. The whole evaluation system is divided into three levels: target level, criterion level and indicator level. Among them, criterion level is divided into three categories, as shown in figure 1.
2.3. Questionnaire survey and data collection
In Chengdu university of science and engineering students, the author of this paper design the questionnaire survey, the questionnaire (see the appendix) mainly aimed at the Chengdu university of technology institute of nuclear technology and automation engineering, institute of geophysics, school of earth sciences, materials and chemical industry and environment and civil engineering institute of several remarkable characteristics of college students in engineering, professional cover each college is about more than 30 professional students, to ensure the comprehensive and objective of the questionnaire survey, reliability, and representative.

A total of 417 people answered the questionnaire effectively, of which 299 were male, accounting for 71.7%, and 118 were female, accounting for 28.3%. The number of participants in each grade was 1 freshman (0.24%), 23 sophomores (5.52%), 211 junior (50.6%), and 182 senior (43.65%). Since there is only one freshman and the effect of innovation and entrepreneurship education is not outstanding, in order to avoid the resulting errors, it is eliminated. Among the five majors in each college, only one was recovered, which was not representative and was also eliminated. Therefore, the final actual recovery of this questionnaire survey was 411, with a good recovery effect, which could meet the analysis needs. The specific sample statistics are shown in table 1.
### Table 1. Statistical data of questionnaire samples

| Category 1     | Quantity | Procedure cache | Percent |
|----------------|----------|-----------------|---------|
| schoolboy      | 299 people |                 | 71.7%   |
| schoolgirl     | 118 people |                 | 28.3%   |

| Category 2     | Quantity | Procedure cache | Percent |
|----------------|----------|-----------------|---------|
| sophomore majoring | 23 portions |                 | 5.52%   |
| junior majoring | 211 portions |                 | 50.6%   |
| senior majoring | 182 portions |                 | 43.65%  |

| Category 3     | Quantity | Procedure cache | Percent |
|----------------|----------|-----------------|---------|
| College of nuclear technology and automation engineering | 71 portions |                 | 17.03%  |
| School of geophysics | 27 portions |                 | 6.47%   |
| School of GeoSciences | 49 portions |                 | 11.75%  |
| School of materials and chemistry, chemistry and chemical engineering | 30 portions |                 | 7.19%   |
| School of environmental and civil engineering | 240 portions |                 | 57.55%  |

2.4. Application of BP neural network

The number of nodes in the input layer is determined by the index factors of innovation and entrepreneurship quality evaluation of engineering majors in colleges and universities. It can be known from the previous index construction part that the evaluation system in this study has 31 indicators, so the number of nodes in the input layer of the improved BP neural network model is 31.

The number of nodes in the hidden layer is related to the number of nodes in the input layer and the number of nodes in the output layer. The selection of the number of nodes in the hidden layer usually affects the quality of the selected neural network model. The determination of the number of nodes in the hidden layer generally adopts the following formula:

\[ S_2 = \sqrt{S_1 + S_3 + q} \]  

(1)

In the formula, S1 is the number of nodes in the input layer, S3 is the number of nodes in the output layer, S2 is the number of nodes in the desired hidden layer, q is a constant of 1-10, and the number of nodes in the hidden layer is calculated as 8 through trial and error.

The number of nodes in the output layer is the evaluation result. In this paper, the engineering major of Chengdu University of science and technology is taken as an example for evaluation, so the number of nodes in the output layer is 1.

In this paper, analytic hierarchy process (AHP) is used to determine the influence degree of each evaluation index on the upper layer, that is, the weight value. By previous studies, this paper analyzes the role of the relationship between each factor of the target layer, criterion layer and index layer, and then start from the bottom, judge the effect of lower index of the last index size, with 1-9 scaling method to value assignment of index, and through comparing the two, the judging matrix was established and the weight of each index is calculated. The assignment of 1-9 scale method is assumed as follows.
Table 2. Assignment hypothesis of scaling method

| Degree of relative importance | determined value |
|-------------------------------|-----------------|
| most importantly              | 9               |
| a great many                  | 7               |
| importance                    | 5               |
| Slightly more important       | 3               |
| the same importance           | 1               |
| Slightly unimportant          | 1/3             |
| unimportance                  | 1/5             |
| trivial                       | 1/7             |
| the least important           | 1/9             |
| Between two adjacent judgments| 2, 4, 6, 8, 1/2, 1/4, 1/6, 1/8 |

By evaluating the importance of each index through the assignment hypothesis table, the weight judgment matrix of target layer, criterion layer and index layer is obtained: G-C, C1-P, C2-P, C3-p. (G is the quality evaluation of innovation and entrepreneurship education, C1 is the professional link, C2 is the teaching link, C3 is the student level, and P is each indicator), which is shown in the following tables.

Table 3. Weight judgment matrix G—C

| G   | C1  | C2  | C3  | Weight |
|-----|-----|-----|-----|--------|
| C1  | 1   | 5   | 3   | 0.63   |
| C2  | 1/5 | 1   | 1/3 | 0.11   |
| C3  | 1/3 | 3   | 1   | 0.26   |

Table 4. Weight judgment matrix C2—P

| C2   | X14 | X15 | X16 | X17 | X18 | weight |
|------|-----|-----|-----|-----|-----|--------|
| X14  | 1   | 1   | 1   | 1/3 | 1/3 | 0.11   |
| X15  | 1   | 1   | 1   | 1/3 | 1/3 | 0.11   |
| X16  | 1   | 1   | 1   | 1/3 | 1/3 | 0.11   |
| X17  | 3   | 3   | 3   | 1   | 1   | 0.33   |
| X18  | 3   | 3   | 3   | 1   | 1   | 0.33   |

Table 5. Output value classification

| rank partition | Neural network output |
|----------------|-----------------------|
| Excellent      | 1.00-0.90             |
| favorable      | 0.89-0.80             |
| intermediate   | 0.79-0.70             |
| pass           | 0.69-0.60             |
| fail           | under 0.59            |

According to the data collation and normalized processing of the index scale calculated by the evaluation system of innovation and entrepreneurship quality for engineering majors of Chengdu university of technology, the number of nodes in each layer was calculated, the neural network model was established, and MATLAB software was used to carry out neural network training, generate the model, input test data and conduct simulation calculation, simulation results and prediction samples are shown in figure 2 and figure 3.
3. Results and discussion

Through investigation and study and the paper quality evaluation results, we can see that among the 31 indicators, 3 were between 0.89 and 0.8, 9 were between 0.79 and 0.7, 8 were between 0.69 and 0.6, and 11 were below 0.59, in a passing grade, indicates the quality of college engineering specialty innovative entrepreneurial education is still in the elementary level, have greatly improvement space, but also achieved some achievements in some aspects.

3.1. Achievements in innovation and entrepreneurship education for engineering majors

3.1.1. Innovation and entrepreneurship knowledge teaching has a good effect

Through the analysis of the evaluation results of \( X_5 = 0.85, X_{14} = 0.83 \) and \( X_{24} = 0.83 \), it can be concluded that the teaching method of innovation and entrepreneurship is popular among students. The unique and innovative teaching method is conducive to increasing students' interest in innovation and entrepreneurship, ensuring their concentration in class, improving the effect of classroom transformation, and thus increasing the participation rate of innovation and entrepreneurship activities.

3.1.2. Achievements in innovation and entrepreneurship improved

\( X_{17} = 0.78 \), with the result of evaluating \( X_{22} = 0.75, X_{29} = 0.70 \) analysis, preliminary results were obtained in college engineering specialty innovative entrepreneurship education, teachers use their resources to assist and guide the students to participate in the campus and campus platform inside and outside the relevant science and technology competition, exercise the student's innovation ability, can make students better contact with cutting edge innovative undertaking and understanding the dynamic
changes of the industry, is conducive to innovation for the future business situation to make objective judgment, increase the success rate.

3.1.3. Awareness of innovation and entrepreneurship has increased
In terms of evaluation indexes, X21=0.73, X25=0.76, X27=0.71 and X30=0.73, innovation and entrepreneurship education of engineering majors in colleges and universities has begun to focus on students' awareness of innovation and entrepreneurship and the ability to cultivate innovation and entrepreneurship, instead of only focusing on hard indicators such as entrepreneurship rate.

3.2. Shortage of innovation and entrepreneurship education in engineering majors in colleges and universities

3.2.1. Lack of teachers for innovation and entrepreneurship education
According to the analysis of evaluation indexes X1=0.64, X2=0.68 and X4=0.41, the proportion of teachers with certain achievements in the field of innovation and entrepreneurship in colleges and universities is relatively small, and the lack of relevant practical experience often leads to the disconnection between theory and practice, hindering the development of innovation and entrepreneurship education in colleges and universities.

3.2.2. Innovation and entrepreneurship knowledge is not closely integrated with professional knowledge
X6 = 0.65 in the work of evaluation index, X9 = 0.28, now most of the existing business entrepreneurship education and professional education section, accounts for a smaller practice courses, students less opportunity to develop itself by actual operation, to meet the needs of students to form a certain innovative entrepreneurial literacy, teaching content and innovative undertaking professional knowledge failed to organic unity together, to reach the purpose of using their own advantages to better innovation entrepreneurship, failed to innovative entrepreneurship education closely associated with students' education, professional knowledge in business entrepreneurship education idea failed to fusion.

3.2.3. The teaching system of innovation and entrepreneurship is not perfect
X18 = 0.64 evaluation indices, X19 = 0.49, college engineering specialty innovative entrepreneurship education teaching system is not perfect, did not establish relevant systems of the building, innovation entrepreneurship courses to learn more courses in the form of, or in the form of lecture lectures on, not set corresponding innovation entrepreneurship course credits, can not cause enough attention to students. There are few extracurricular practical activities, the proportion of class hours of practical courses is small, and the teaching purpose and teaching policy are not clear, which cannot guarantee the internal change of students' innovative and entrepreneurial thinking and ability, which often leads to the problem of treating the symptoms rather than the root cause.

3.2.4. The utilization rate of innovation and entrepreneurship resources is not high
By 8 = 0.40 evaluation indices, X26 = 0.64, engineering major is needed at a certain experimental process, theory or practice experience as engineering specialty in colleges and universities related laboratory quantity is insufficient, the imperfection of the laboratory facilities, not to let students get enough exercise, not effectively stimulate students' innovative entrepreneurial zeal, the innovation of the schools and colleges set up platform for business incubation park utilization rate is not high, not enough publicity, the use of the platform for most of the students' innovation and related policy is not enough to understand, to a certain extent can inhibit students to participate in the activities of innovative entrepreneurial ideas.
4. Conclusion
Starting from the research status of innovation and entrepreneurship education and the evaluation of innovation and entrepreneurship education quality, this paper determines the index system of innovation and entrepreneurship education quality evaluation applicable to the engineering majors in local universities. Through in-depth analysis and research of engineering specialty, the first-level indexes of three levels of engineering specialty are determined, namely, professional link, teaching link and student level. A neural network model for quality evaluation of engineering innovation and entrepreneurship education in universities is established. Through the analysis of the innovative undertaking quality evaluation method, using BP neural network model generalization ability and advantages of nonlinear processing capability index to quantify the problem, on the processing of data, using the AHP to calculate the weight of each index, the result of the weight analysis prove the feasibility of the BP neural network model is established in this paper, for quality assessment of college engineering specialty innovative entrepreneurship education provide new method and train of thought.

Acknowledgement
This work was funded by the Sichuan provincial higher education talent cultivation quality and teaching reform project 2018-2020 (JG2018-485), Chengdu university of technology 2018-2020 higher education personnel training quality and teaching reform project (JG183086) and Chengdu university of technology, local undergraduate university students innovation and entrepreneurship education research base construction project (YJ2017-JD002).

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