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Sustainable Development Evaluation of Innovation and Entrepreneurship Education of Clean Energy Major in Colleges and Universities Based on SPA-VFS and GRNN Optimized by Chaos Bat Algorithm

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Abstract: The research on the sustainability evaluation of innovation and entrepreneurship education for clean energy majors in colleges and universities can not only cultivate more and better innovative and entrepreneurial talents for the development of sustainable energy but also provide a reference for the sustainable development of innovation and entrepreneurship education for other majors. To achieve systematic and comprehensive scientific evaluation, this paper proposes an evaluation model based on SPA-VFS and Chaos bat algorithm to optimize GRNN. Firstly, the sustainability evaluation index system of innovation and entrepreneurship education for clean energy major in colleges and universities is constructed from the four aspects of the environment, investment, process, and results, and the meaning of each evaluation index is explained; Then, combined with variable fuzzy set evaluation theory (VFS) and set pair analysis theory (SPA), the classical evaluation model based on SPA-VFS is constructed, and the entropy weight method and rank method are coupled to obtain the index weight. The basic bat algorithm is improved by using Tent chaotic mapping, and the chaotic bat algorithm (CBA) is proposed. The generalized regression neural network (GRNN) model is optimized by CBA, and the intelligent evaluation model based on CBA-GRNN is obtained to realize fast real-time calculation; finally, a numerical example is used to verify the scientificity and accuracy of the model proposed in this paper. This study is conducive to a comprehensive evaluation of the sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities, and is conducive to the healthy and sustainable development of innovation and entrepreneurship education for clean energy major in colleges and universities, so as to provide more innovative and entrepreneurial talents for the clean energy industry.

Keywords: clean energy major in colleges and universities; innovation and entrepreneurship education; evaluation of sustainable development; variable fuzzy sets; set pair analysis; Chaos bat algorithm; generalized regression neural network

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1. Introduction

In recent years, clean energy as sustainable energy is in a period of rapid development, and a large number of innovative and entrepreneurial talents are urgently needed. Therefore, innovation and entrepreneurship education has gradually begun to appear frequently in the education of clean energy major in colleges and universities [1]. However, the increase in quantity has not brought about quality improvement, and the quality of development has been uneven. The sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities faces many challenges [2].

'Sustainable development theory' appears frequently in the field of economic and social research, but because the innovation and entrepreneurship education of clean energy major in colleges and universities has been vigorously promoted in recent years, the research from the perspective of sustainable development theory is rare. The main task of higher education for the major of clean energy is to improve the quality of education, promote the all-round development of education objects, and then transport more talents for the development of the clean energy industry [3]. First of all, the quality of college education is reflected in the quality of college education itself, which should be consistent with the direction of social development and committed to brand building with certain competitiveness and influence. Secondly, the quality of college education is also reflected in the quality of individual cultivation of college students, that is, college education can promote the development of individuals and cultivate useful talents for the society. The relationship between higher education and sustainable development is one of complementarity and mutual promotion, and students are the link and bridge between the two. Therefore, it is of great significance to deeply understand the value orientation of "people-oriented" higher education development, follow the objective law of education development and the theory of sustainable development, and deal with the relationship between the sustainable development of innovation and entrepreneurship education for clean energy major and the development of students, colleges and universities, and economic and social development [4]. Especially at this stage, innovation and entrepreneurship education is developing from focusing on the scale of education to improving the quality of education, and it is more necessary to implement the concept of sustainable development [5]. To further realize the sustainable development of innovation and entrepreneurship education for clean energy major in colleges and universities, and better play the role of education, it is necessary to scientifically evaluate sustainability, so as to find out the problems existing in the sustainable development of innovation and entrepreneurship education for clean energy major in colleges and universities, and provide reference and suggestions to improve sustainability.

Existing studies show the importance of clean energy development [6–8]. It can be also found that using fossil fuels for energy has to be changed in the near future [9]. There is no relevant research on the sustainability evaluation of innovation and entrepreneurship education for clean energy major in colleges and universities, but there have been studies on the connotation and role of innovation and entrepreneurship education in colleges and universities. Jonsdottir [10] studied the situation of innovation and entrepreneurship education in Icelandic colleges and believed that innovation and creative thinking, as necessary tools to improve students' entrepreneurial ability, formed a unity of innovation and entrepreneurship education, and put forward that innovation education and entrepreneurship education are two sides of a coin. Cruz et al. [11] studied the impact of entrepreneurship education projects on innovation. It is believed that students receiving management education and entrepreneurship education have more innovative ability than ordinary people, and those who have received professional innovation education and entrepreneurship education are more likely to succeed in their work. In addition, studies on other aspects of innovation and entrepreneurship education have begun to emerge. For example, Beiler [12] believed that the Kern Entrepreneurship Education Network (KEEN) implemented in the United States integrates the concept of innovation and entrepreneurship into professional courses, which can cultivate students' innovative entrepreneurial thinking and problem-solving ability, and begin to evaluate students' innovative thinking and cooperation ability based on their internship scores in schools or enterprises. Mars [13] evaluated the quality of agricultural innovation and entrepreneurship education teachers, and considered that agricultural teachers' innovation and entrepreneurship awareness and practical ability should be used as evaluation indexes of innovation and entrepreneurship education. The quality of teachers' innovation and entrepreneurship and the implementation of innovation and entrepreneurship education directly affect the cultivation of students' innovation and entrepreneurship awareness and the formation of innovation and entrepreneurship literacy. Cultivating an excellent teaching staff of innovation and entrepreneurship education is the key to the implementation of innovation and entrepreneurship. Herstatt et al. [14] believed that the evaluation of innovation and entrepreneurship education is an integral part of education evaluation, and evaluates graduate students' entrepreneurship education through the Global Innovation Management plan. The evaluation indexes include students' behavior, innovation intention, knowledge acquisition, and skill return, which involve process evaluation and result evaluation. Through the above analysis, it can be found that the connotation of innovation and entrepreneurship education is gradually clear, and the importance of innovation and entrepreneurship education evaluation is increasingly prominent [15]. However, research on the evaluation of innovation and entrepreneurship education remains to be deepened, especially the lack of systematic, comprehensive, and scientific research on the sustainability evaluation of innovation and entrepreneurship education. Therefore, this paper develops an evaluation system that can quantitatively analyze the sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities.

On the evaluation method, the existing evaluation methods have important reference value for the sustainable evaluation of innovation and entrepreneurship education of clean energy major in colleges and universities. By combing and analyzing the relevant comprehensive evaluation methods, it can be found that the evaluation methods mainly include classical evaluation methods and modern intelligent evaluation methods. Classical evaluation methods [16] include entropy weight method, fuzzy analytic hierarchy process, set pair evaluation method, principal component analysis, ideal point method, etc. Modern intelligent evaluation methods [17] mainly include the back propagation neural network (BPNN) evaluation method and support vector machine (SVM) evaluation method. In consideration of the fact that the classic evaluation method is relatively mature and the calculation result is more accurate, but the calculation process is more complicated, and the modern intelligent evaluation method can quickly and accurately process massive real-time data. This paper intends to combine the classical evaluation method and modern intelligent evaluation method to evaluate the sustainability of innovation and entrepreneurship education of clean energy major in colleges and universities. Set pair analysis (SPA) can be used to characterize the internal correlation between sets [18], and the variable fuzzy set method (VFS) can describe the dynamic changes between sets [19] in detail. Therefore, the combination of SPA and VFS can be applied to the sustainability evaluation of innovation and entrepreneurship education for clean energy major in colleges and universities. The index weight determination in the SPA and VFS coupling model is particularly important, which is worthy of further discussion. In this paper, an improved set pair analysis-variable fuzzy set coupling evaluation model (SPA-VFS) is established by coupling rank method [20] with entropy weight method [21]. In modern intelligent evaluation methods, the BPNN evaluation method has the problems of slow convergence and easy to fall into local optimum [22]. The SVM evaluation method is difficult to obtain ideal prediction accuracy when dealing with large-scale training samples [23]. Generalized regression neural network (GRNN) is a radial basis function neural network proposed by Specht, which has a strong ability of nonlinear mapping [24]. Compared with BPNN and SVM, GRNN has fewer adjustment parameters, is not easy to fall into a local minimum, and is good at dealing with large-scale training samples [25]. In addition, GRNN has an advantage in forecasting volatile data [26]. Therefore, this paper selected the GRNN model for intelligent evaluation. However, the smoothing factor selection is blind in the basic GRNN model [27], so it is necessary to select the appropriate intelligent algorithm to optimize it. The bat algorithm is a new bionic intelligent optimization algorithm proposed by Yang in 2010 [28]. The algorithm realizes the search of the population in solution space by simulating the predation behavior of bats. Compared with swarm intelligence optimization methods such as particle swarm optimizer (PSO) algorithm, the algorithm has the advantages of a simple model, fewer control parameters, and fast convergence speed, but it also has the disadvantages of easily falling into local optimum and poor population diversity [29]. Considering that the introduction of a Tent chaotic map can further enhance the global optimization ability of the bat population, this paper uses Tent chaotic map to improve the basic bat algorithm, and proposes a chaotic bat algorithm (CBA), in order to improve the global convergence of the population and improve its performance, and uses CBA algorithm to optimize GRNN model.

The main contributions of this article are the following:

(1) The evaluation index system of the sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities is constructed from four aspects: environment, investment, process and result, which solves the problem of what aspects of the sustainability of the innovation and entrepreneurship education for clean energy major in colleges and universities are mainly reflected.
(2) The evaluation index weights are obtained based on the combined entropy weight rank order method, and the SPA-VFS evaluation model is designed to obtain the evaluation results from the perspective of classical evaluation methods.
(3) The basic bat algorithm is improved by using Tent chaotic mapping to form a novel chaotic bat algorithm, and the intelligent evaluation model is constructed by using CBA to optimize GRNN. It provides decision support for promoting the sustainable development of innovation and entrepreneurship education for clean energy major in colleges and universities.

In summary, this paper constructs a system that can quantitatively evaluate the sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities. The rest of the paper is arranged as follows. In Section 2, the evaluation index system of the sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities is designed from the four aspects of the environment, investment, process, and results of innovation and entrepreneurship education for clean energy major in colleges and universities, and the evaluation indexes are explained. Section 3 builds a classic evaluation model based on SPA-VFS and builds a weight calculation model based on the combined entropy weight rank method. Section 4 constructs an intelligent evaluation model based on CBA optimized GRNN. Section 5 selects practical cases to verify the accuracy and effectiveness of the model proposed in this paper. Section 6 summarizes the research results of the article.

2. Sustainability Evaluation Criteria System for Innovation and Entrepreneurship Education of Clean Energy Major in Colleges and Universities

2.1. Sustainable Evaluation Index System

To implement the sustainable evaluation of innovation and entrepreneurship education of clean energy major in colleges and universities, it is needful to first clarify the connotation of the evaluation object. The innovation and entrepreneurship education of clean energy majors in colleges and universities studied in this paper takes undergraduate education as the research object, and takes both professional theory and professional practice into account. According to the research status at home and abroad, this paper interprets the innovation and entrepreneurship of clean energy major as in-novation-based entrepreneurship in the field of clean energy-related major. Innovation is the premise of entrepreneurship, and it is all activities that can bring new value to resources. It is not only technological innovation but also includes management innovation, knowledge innovation, process innovation, marketing innovation, etc. The innovation and entrepreneurship education of clean energy major is based on innovation-based entrepreneurship education [30]. On the one hand, the sustainability of innovation and entrepreneurship education for clean energy major in colleges and universities is reflected in the sustainable development of individual cultivation of clean energy major in colleges and universities. That is to say, it can combine the training objectives of innovation and entrepreneurship education for clean energy major to cultivate the management ability of clean energy major in colleges and universities, promote the development of individuals, improve comprehensive management quality, and cultivate compound senior management talents with the concept of sustainable development for clean energy enterprises [31]. On the other hand, it is reflected in the sustainable development of innovation and entrepreneurship education of clean energy major in colleges and universities. It should be consistent with the direction of social development and energy revolution and be committed to the shaping of brands. It should be consistent with the school-running mechanism, management system, layout structure, faculty, discipline construction, school-running scale, school-running level, and its own development mechanism and ecological environment, so as to make it competitive and influential, and enable students of clean energy major in colleges and universities to truly benefit, so as to realize the "win-win" sustainable development of the subject and object of innovation and entrepreneurship education of clean energy major [32]. On the basis of understanding the connotation of sustainable innovation and entrepreneurship education of clean energy major in colleges and universities, according to the logical relationship between each index, the sustainable evaluation index system of innovation and entrepreneurship education of clean energy major in colleges and universities is constructed, as shown in Table 1. The evaluation index system includes 4 first-level indicators, 11 second-level indicators, and 28 third-level indicators. The four first-level indicators are the innovation and entrepreneurship education environment of clean energy major in colleges and universities, the innovation and entrepreneurship education investment of clean energy major in colleges and universities, the innovation and entrepreneurship education process of clean energy major in colleges and universities, and the innovation and entrepreneurship education results of clean energy major in colleges and universities.

Table 1. Sustainable Evaluation Index System of Innovation and Entrepreneurship Education for Clean Energy Major in Colleges and Universities.

First Grade Indexes	Second Index	Third Grade Indexes
Innovation and Entrepreneurship Education Environment of Clean Energy Major in Colleges and Universities (C)	External support environment (C1)	Government support policy (C11) Social assistance (C12)
	School implementation environment (C2)	Clean energy major training program (C21) Organization and management institution setting (C22) Entrepreneurship income distribution system (C23)
	Entrepreneurship of clean energy major (C3)	Technology transfer (C33)
Investment in Innovation and Entrepreneurship Education of Clean Energy Major in Colleges and Universities (I)	Faculty of clean energy major (I1)	Teaching staffing of clean energy Major (I11) The proportion of external tutors of clean energy major in entrepreneurship guidance teachers (I12) The teacher-student ratio of innovation and entrepreneurship in clean energy major (I13) The proportion of clean energy teachers with entrepreneurial experience (I14)
	Funding of clean energy major (I2)	The proportion of school funds in innovation and entrepreneurship education of clean energy major in total school education funds (I21) Personal input of students majoring in clean energy (I22)
	Practice platform of clean energy major (I3)	Practice teaching base of clean energy major (I31) Clean energy innovation and entrepreneurship activities (I32) Clean energy professional practice base opening (I33)
Innovation and Entrepreneurship Education Process of Clean Energy Major in Colleges and Universities (P)	Curriculum system of clean energy major (P1)	The number of innovation and entrepreneurship courses accounted for the proportion of professional courses of clean energy major (P11) The proportion of innovation and entrepreneurship course hours in the total course hours of clean energy major (P12) The proportion of credits for innovation and entrepreneurship courses to the total credits for clean energy major (P13) The penetration of innovation and entrepreneurship courses in clean energy major (P14)
	Service guidance support of clean energy major (P2)	Information release of innovation and entrepreneurship in clean energy (P21) The construction of innovative and entrepreneurial guidance institutions for clean energy (P22) The construction of innovative and entrepreneurial education associations for clean energy (P23)
	Student participation process of clean energy major (P3)	Attendance rate of clean energy students' innovation and entrepreneurship courses (P31) Participation of clean energy students in innovation and entrepreneurship activities (P32)

Table 1. *Cont.*

First Grade Indexes	Second Index	Third Grade Indexes
Results of Innovation and Entrepreneurship Education for Clean Energy Major in Colleges and Universities (R)	Social impact (R1)	Proportion of clean energy graduates with success in innovation and entrepreneurship (R11) Base training clean energy enterprises (R12)
	Education effectiveness of clean energy major (R2)	The improvement of entrepreneurial quality of students majoring in clean energy (R21) The proportion of graduates majoring in clean energy in employment (R22)

2.2. Selection of Evaluation Indexes

(1) Government support policy: the local government for colleges and universities to carry out innovation and entrepreneurship education-related support policies, including financial support policies, incentive policies.

(2) Social assistance: social organizations, institutions, or successful alumni donated funds, equipment, or venues for innovation and entrepreneurship education of clean energy major in colleges and universities.

(3) Clean energy major training program: talent training scheme of innovation and entrepreneurship education for clean energy major in colleges and universities, including training objectives, knowledge and ability requirements, graduation requirements, etc.

(4) Organization and management institution setting: the organization and management institution setting for the effective innovation and entrepreneurship education of clean energy major in colleges and universities.

(5) Entrepreneurship income distribution system: the distribution system of clean energy major in colleges and universities is formulated for the distribution of income obtained by teachers, students, and other stakeholders in innovative and entrepreneurial activities.

(6) Technology transfer: the transfer of technical achievements or patents obtained by the school clean energy major to others, to achieve the social and economic value of technical achievements or patents.

(7) Teaching staffing of clean energy major: the number of teachers meets the situation of innovation and entrepreneurship education for clean energy major.

(8) The proportion of external tutors of clean energy major in entrepreneurship guidance teachers: reflecting the external employment of enterprise engineers, entrepreneurial elites, innovation and entrepreneurship experts in the field of clean energy from the school to meet the education of innovation and entrepreneurship of clean energy major.

(9) The teacher-student ratio of innovation and entrepreneurship in clean energy major: the ratio of teachers specialized in innovation and entrepreneurship education in clean energy major to the number of students in need of innovation and entrepreneurship.

(10) The proportion of clean energy teachers with entrepreneurial experience: the proportion of clean energy teachers with entrepreneurial experience accounted for the total number of teachers.

(11) The proportion of school funds in innovation and entrepreneurship education of clean energy major in total school education funds: funds allocated to ensure the normal development of innovation and entrepreneurship education activities for clean energy major.

(12) Personal input of students majoring in clean energy: the personal financial or material investment of clean energy students in innovation and entrepreneurship activities.

(13) Practice teaching base of clean energy major: the number of practice bases and the scale of students that can be accommodated in the construction of innovation and entrepreneurship education for clean energy majors or in cooperation with other subjects.

(14) Clean energy innovation and entrepreneurship activities: the frequency of clean energy innovation and entrepreneurship competitions and forums held by colleges and

universities and the scale of teachers and students to meet the needs of innovation and entrepreneurship.

(15) Clean energy professional practice base opening: the open level of resources for teachers and students in the practice base of clean energy innovation and entrepreneurship education at home and abroad.

(16) The number of innovation and entrepreneurship courses accounted for the proportion of professional courses of clean energy major: the number of courses for innovation and entrepreneurship in clean energy major accounts for the proportion of the total number of courses.

(17) The proportion of innovation and entrepreneurship course hours in the total course hours of clean energy major: the proportion of innovation and entrepreneurship courses in clean energy major in colleges and universities accounts for the total hours of the course.

(18) The proportion of credits for innovation and entrepreneurship courses to the total credits for clean energy major: the credit of innovation and entrepreneurship course of clean energy major in colleges and universities accounts for the proportion of the total credit of the course.

(19) The penetration of innovation and entrepreneurship courses in clean energy major: the current situation and effect of the cultivation concept of innovation spirit, entrepreneurship awareness and innovation and entrepreneurship ability penetrating into the curriculum and practice teaching of clean energy in colleges and universities are investigated.

(20) Information release of innovation and entrepreneurship in clean energy: universities publish clean energy innovation and entrepreneurship competition projects, training and other activities or policy information and service information about clean energy innovation and entrepreneurship.

(21) The construction of innovative and entrepreneurial guidance institutions for clean energy: innovation and entrepreneurship guidance service, energy policy and development analysis, fiscal and taxation policy introduction, experience introduction and other service institutions of clean energy major in colleges and universities.

(22) The construction of innovative and entrepreneurial education associations for clean energy: the construction of clean energy entrepreneurship clubs, future entrepreneurs' associations and youth entrepreneurship associations.

(23) Attendance rate of clean energy students' innovation and entrepreneurship courses: the attendance of clean energy students in innovation and entrepreneurship courses

(24) Participation of clean energy students in innovation and entrepreneurship activities: proportion of students participating in innovation and entrepreneurship practice in clean energy majors.

(25) Proportion of clean energy graduates with success in innovation and entrepreneurship: the number of successful innovation and entrepreneurship of previous clean energy graduates accounted for the proportion of graduates in the year.

(26) Base training clean energy enterprises: college students or teachers have successfully established clean energy enterprises through the entrepreneurial base platform:

(27) The improvement of entrepreneurial quality of students majoring in clean energy: the improvement of innovation and entrepreneurship quality and ability of clean energy students receiving innovation and entrepreneurship education in colleges and universities.

(28) The proportion of graduates majoring in clean energy in employment: the proportion of self-employed graduates in clean energy major who use entrepreneurship as career planning or entrepreneurial activity to the total number of employed students.

3. Construction of Classical Evaluation Model

3.1. Weight Calculation Model Based on Combined Entropy Weight Rank Order Method

The entropy weight method reflects the amount of information according to the information entropy of the evaluation index, so as to determine the weight of each index in the evaluation system, but sometimes the random interference of the data itself will lead to the lack of real reliability of the calculated weight [33]. The rank order (RO) method can rank the normalized mean values of each index from large to small, and the weight obtained by rank can objectively reflect the influence degree of evaluation index on evaluation objects [34]. In this paper, the entropy weight method and RO method are combined, and the combination entropy weight rank order method is proposed, and the weight obtained is more realistic.

3.1.1. RO Method

The specific steps of RO method are as follows [35]:

1. Data normalization processing.

There are various types of indicators, including maximal indicators, minimal indicators and interval indicators. Maximal indicators reflect the development trend of evaluation index, the index increases, the higher the level of sustainable development; On the contrary, very small indicators show that the indicators increase, the lower the level of sustainable development. In order to facilitate the calculation and analysis, the values of each index must be consistent, so as to facilitate the comparison and selection of each scheme, and then get the evaluation results of each scheme. After analyzing the index system constructed in this paper, it is found that all evaluation indexes are maximal indicators. Due to the large differences in the attributes and quantity levels of the original data indicators, it is necessary to normalize each indicator. Let the evaluation sample set be $\{x_{ij}|i = 1, 2, \cdots, m; j = 1, 2, \cdots, n\}$. The calculation formula is as follows:

$$x'_{ij} = \frac{x_{ij} - \min\{x_{ij}\}}{\max\{x_{ij}\} - \min\{x_{ij}\}}, \tag{1}$$

where, x'_{ij} is the normalized value of x_{ij}; $\max\{x_{ij}\}$ and $\min\{x_{ij}\}$ are the maximum and minimum values in the sample set respectively.

2. The average value $\overline{x_i}'(i = 1, 2, \cdots, m)$ of each evaluation index sample was calculated by x'_{ij}, and sorted by size, with the serial number R'_i. The maximum number corresponds to number m, and the minimum number corresponds to number 1. Order number R'_i is rank, and the greater the value, the greater the impact of the index on the evaluation object.
3. Calculate the weight of each index $\omega_{(1)i}(i = 1, 2, \cdots, m)$, namely:

$$\omega_{(1)i} = R'_i / \sum_{i=1}^{m} R'_i, \tag{2}$$

3.1.2. Entropy Weight Method

The information entropy H_i and weight $\omega_{(2)i}$ of each index are calculated, namely [36]:

$$k = 1/\ln n, \tag{3}$$

$$f_{ij} = x'_{ij} / \sum_{j=1}^{n} x'_{ij}, \tag{4}$$

$$H_i = -\left(k \sum_{j=1}^{n} f_{ij}\right) \ln f_{ij}, \tag{5}$$

$$\omega_{(2)i} = (1 - H_i) / \left(m - \sum_{i=1}^{m} H_i \right), \tag{6}$$

when $f_{ij} = 0$, $f_{ij} \ln f_{ij} = 0$.

3.1.3. Combination Weight Calculation

Combined weights $\omega_{(1)i}$ calculated by weights $\omega_{(2)i}$ and ω_i:

$$\omega_i = \omega_{(1)i}\omega_{(2)i} / \sum_{i=1}^{m} \omega_{(1)i}\omega_{(2)i}, \tag{7}$$

3.2. SPA-VFS

In this paper, VFS coupling evaluation theory is used to improve set pair analysis, and SPA-VFS model is constructed. The model considers the multi-scale fuzzy relationship between the evaluation index value and the grade standard, and pays attention to the influence of the evaluation index on the evaluation object. The basic steps are as follows.

1. Determine the evaluation index x_i ($i = 1, 2, \ldots, m$, m is the number of evaluation indexes) and evaluation grade standard of the evaluation object $[h_{ig-1}, h_{ig}]$ (i = 1,2,..., m; g = 1,2,..., C; C is the number of grade).
2. Based on the basic principles of the set pair analysis method [37], x_{ij}, h_{ig} are taken as two sets and constructed as a set pair. Then analyze from three levels of similarity, difference, and opposite, and obtain the degree of connection μ_{ijg} between the j sample under indicator i and grade g:

$$\mu_{ijg} = a + bI + cJ, \tag{8}$$

where a, b, c are similarity degree, difference degree, opposite degree, and $a + b + c = 1$; I is the coefficient of difference degree ($I \in [-1, 1]$), which can be reasonably determined according to the research object; J is the coefficient of contrary degree ($J = -1$).

Considering the simplicity of connection degree calculation, the fuzziness of evaluation objects and evaluation criteria, the membership function is used to determine μ_{ijg}, which avoids the direct calculation of a, b, c in Equation (8). If a, b, c belong to the same level, then $\mu_{ijg} = 1$; if a, b, c are adjacent grades, then $\mu_{ijg} \in [-1, 1]$; If they belong to the interval grade, then $\mu_{ijg} = -1$. The calculation formula of connection degree under five levels (1–5 levels represent low, relative low, average, relative high, high) is as follows.

$$\mu_{ij1} = \begin{cases} 1 x_{ij} \le h_{i1} \\ 1 - 2 \cdot \left| \frac{x_{ij} - h_{i1}}{h_{i2} - h_{i1}} \right| h_{i1} < x_{ij} \le h_{i2} \\ -1 x_{ij} > h_{i2} \end{cases}, \tag{9}$$

$$\mu_{ij2} = \begin{cases} 1 - 2 \cdot \left| \frac{h_{i1} - x_{ij}}{h_{i1}} \right| x_{ij} \le h_{i1} \\ 1 h_{i1} < x_{ij} \le h_{i2} \\ 1 - 2 \cdot \left| \frac{x_{ij} - h_{i2}}{h_{i3} - h_{i2}} \right| h_{i2} < x_{ij} \le h_{i3} \\ -1 x_{ij} > h_{i3} \end{cases}, \tag{10}$$

$$\mu_{ij3} = \begin{cases} -1 x_{ij} \le h_{i1} \\ 1 - 2 \cdot \left| \frac{h_{i2} - x_{ij}}{h_{i2} - h_{i1}} \right| h_{i1} < x_{ij} \le h_{i2} \\ 1 h_{i2} < x_{ij} \le h_{i3} \\ 1 - 2 \cdot \left| \frac{x_{ij} - h_{i3}}{h_{i4} - h_{i3}} \right| h_{i3} < x_{ij} \le h_{i4} \\ -1 x_{ij} > h_{i4} \end{cases}, \tag{11}$$

$$\mu_{ij4} = \begin{cases} -1 x_{ij} \le h_{i2} \\ 1 - 2 \cdot \left| \frac{h_{i3} - x_{ij}}{h_{i3} - h_{i2}} \right| h_{i2} < x_{ij} \le h_{i3} \\ 1 h_{i3} < x_{ij} \le h_{i4} \\ 1 - 2 \cdot \left| \frac{x_{ij} - h_{i4}}{h_{i5} - h_{i4}} \right| x_{ij} > h_{i4} \end{cases}, \quad (12)$$

$$\mu_{ij5} = \begin{cases} -1 x_{ij} \le h_{i3} \\ 1 - 2 \cdot \left| \frac{h_{i4} - x_{ij}}{h_{i4} - h_{i3}} \right| h_{i3} < x_{ij} \le h_{i4} \\ 1 x_{ij} > h_{i4} \end{cases}, \quad (13)$$

where, $h_{i1}, h_{i2}, h_{i3}, h_{i4}, h_{i5}$ is the boundary value of each index grade standard.

It can be seen from Equations (9)–(13) that μ_{ijg} makes full use of the same, different and opposite information of x_{ij} and h_{ig}.

3. The comprehensive connection u_{jg} between sample j and evaluation grade g can be obtained by weighting μ_{ijg} and index weight ω_i:

$$\mu_{jg} = \sum_{i=1}^{m} \omega_i \mu_{ijg}, \quad (14)$$

where, $\omega_i \in [0, 1]$ is the weight of the i index. $\mu_{ig} \in [-1, 1]$, u_{jg} values closer to -1, reflecting the smaller consistency between sample j and evaluation grade g; The closer the u_{jg} value is to 1, the greater the consistency between the two is.

4. The relative membership γ_{jg} between sample j and evaluation grade g is calculated. From the meaning of μ_{jg}, μ_{jg} can be regarded as the relative difference in VFS model. VFS model shows that the relative membership degree of sample j and evaluation grade γ_{jg} is:

$$\gamma_{jg} = \left(1 + \mu_{jg}\right)/2, \quad (15)$$

According to the maximum membership criterion, the evaluation grade of the evaluation sample can be estimated by using γ_{jg}, but the maximum membership principle is easy to cause estimation errors. Generally, the grade identification is carried out according to the grade eigenvalue h_j^*:

$$h_j^* = \sum_{g=1}^{C} g \left| \gamma_{jg} / \sum_{g=1}^{C} \gamma_{jg} \right|, \quad (16)$$

where, h_j^* is the level eigenvalue corresponding to sample j, $h_j^* \in [1, C]$.

The evaluation grade of the evaluation sample is calculated according to the following formula:

$$s = \text{ round } \left(h_j^*\right), \quad (17)$$

In the formula, s is the evaluation level of the evaluation sample.

To sum up, the classic evaluation model process based on SPA-VFS is shown in Figure 1.

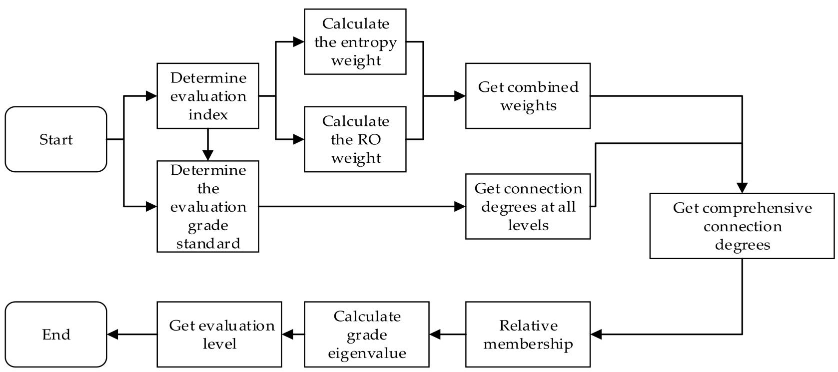

Figure 1. Flow chart of classic evaluation.

4. Construction of Intelligent Evaluation Model

4.1. GRNN

GRNN is proposed by an American scholar Donald F. Specht in 1991, with the theoretical basis of nonlinear regression analysis. As shown in Figure 2, GRNN constitutes four components [38]:

1. The input layer: the original variables enter the network which correspond to the neurons one by one and are submitted to the next layer.
2. The pattern layer: nonlinear transformation is applied to the values received from the input layer. The transfer function of the i neuron in the pattern layer is:

$$P_i = \exp[-(X - X_i)^T (X - X_i)/2\sigma^2] i = 1, 2, \cdots n, \quad (18)$$

where X represents input variable, x_i is the learning sample corresponding to the i neuron; σ is the smoothing parameter.

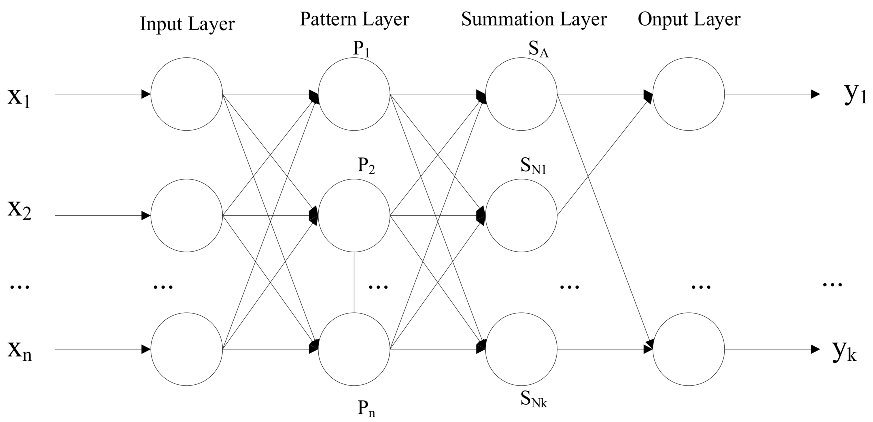

Figure 2. The structure of GRNN.

3. The summation layer: calculate the sum and weighted sum of the pattern outputs.

The summation layer contains two types of neurons, in which one neuron S_A makes arithmetic summation of the output of all pattern layer neurons, and the connection weight of each neuron in the pattern layer to this neuron is 1. Its transfer function is:

$$S_A = \sum_{i=1}^{n} P_i, \quad (19)$$

The output of all neurons in the pattern layer were weighted and summed to gain the other neurons S_{Nj} in the summation layer. The transfer function of the other neurons in the summation layer is:

$$S_{Nj} = \sum_{i=1}^{n} y_{ij} P_i j = 1, 2, \cdots, k, \quad (20)$$

where y_{ij} is the connection weight between the i neuron in the pattern layer and the j neuron in the summation layer. And y_{ij} is the i element in the i output sample y_i.

4. The output layer: the forecasting results can be derived. Output of each neuron is:

$$y_j = \frac{S_{Nj}}{s_A} j = 1, 2, \cdots, k, \quad (21)$$

where y_i is the output of the j neuron.

4.2. Chaos Bat Algorithm

4.2.1. Basic Bat Algorithm

In the basic bat algorithm, each bat represents a feasible solution in the solution space, and iteratively updates the frequency, speed, pulse emission rate, and loudness of each bat in the group to realize the search for the optimal solution [39]. The frequency, velocity and position iteration formula of each bat in the BA algorithm are as follows [40].

$$\begin{gathered} f_i = f_{\min} + (f_{\max} - f_{\min})\beta \\ v_i^t = v_i^{t-1} + \left(x_i^{t-1} - x^*\right) f_i \\ x_i^t = x_i^{t-1} - v_i^t \end{gathered} \tag{22}$$

where f_i is the frequency of the sound pulse emitted by the i bat; f_{max} and f_{min} represent the maximum frequency value and minimum value of the sound wave pulse; β is a uniformly distributed random number between 0 and 1. v_i^t and x_i^t respectively represent the speed and position of bat i in generation t; x^* represents the optimal solution currently found.

Perform a local search near the optimal solution currently searched to generate a random number $rand_1$ between 0 and 1. If $rand\ _1 > r_i$ (the pulse emission rate of bat i), implement the following local search strategy:

$$x_i^t = x^* + \varepsilon A^t, \tag{23}$$

where, ε is a random number uniformly distributed between -1 and 1; A^t is the average loudness of all bats in the t generation.

Then generate a random number $rand_2$ between 0 and 1. If $rand\ _2 < A_i$ (the loudness of the bat i), and $y(x_t^t) < y(x^*)$, then accept the position, and update the bat i's loudness A_i^t and pulse emission rate r_i^t according to Equations (24) and (25):

$$A_i^{t+1} = \alpha A_i^t, \tag{24}$$

$$r_i^{t+1} = r_i^0 [1 - \exp(-\gamma t)], \tag{25}$$

where α is the volume attenuation coefficient; γ is the pulse frequency enhancement coefficient; r_i^0 is the initial pulse emission rate. For any $0 < \alpha < 1, \gamma > 0$, when the number of iterations t tends to infinity, A_i^t tends to 0 and r_i^t tends to r_i^0.

4.2.2. Chaos Strategy in Bat Algorithm

Compared with group intelligent optimization methods such as PSO Algorithm, Bat Algorithm has stronger optimization ability, but it also has the disadvantages of being easy to fall into local optimum and poor population diversity in the later stage of evolution [41]. To improve the global convergence of the population, this paper proposes a CBA based on the Tent chaotic map.

1. Tent mapping [42].

The research shows that compared with Logistic mapping, Tent mapping has better ergodicity and randomness. The mathematical expression of Tent chaotic mapping is:

$$z_{k+1} = \begin{cases} 2z_k & 0 \le\ z_k \le 0.5 \\ 2(1 - z_k) & 0.5 \le\ z_k \le 1 \end{cases}, \tag{26}$$

2. Initialization of bat position using Tent chaotic map.

Compared with the randomly generated initial population, the diversity of bat population can be improved by using Tent chaotic mapping to initialize the population. The steps are as follows:

(1) Generate D random numbers between 0 and 1 to form the initial sequence $z_1 = (z_{1,1}, z_{1,2}, \cdots, z_{1,D})$, where D is the number of control variables.
(2) According to the Formula (27), the chaotic sequence z_i is generated, and the matrix Z:

$$z = \begin{bmatrix} z_{1,1} & z_{1,2} & \cdots & z_{1,D} \\ z_{2,1} & z_{2,2} & \cdots & z_{2,D} \\ \vdots & \vdots & & \vdots \\ z_{Np,1} & z_{Np,2} & \cdots & z_{Np,D} \end{bmatrix}, \quad (27)$$

where Np is the bat population size.

Produce the initial bat population according to Formula (28):

$$x_{ij,0} = x_{j\min} + z_{ij}(x_{j\max} - x_{j\min}), \quad (28)$$

(3) Update pulse emission rate by using Tent chaotic map

The pulse frequency enhancement coefficient γ has great influence on the optimization performance of BA algorithm. When γ is large, the global search ability of the algorithm is strong. When γ is small, although the convergence speed is accelerated, it is easy to be attracted by local optimal solution and fall into local optimum. To balance the global search ability and local mining ability of the algorithm, the Tent chaotic map is used to update the pulse emissivity, as follows:

$$r_i^t = \left[r_i^0 + \frac{(\overline{r_i} - r_i^0)t}{t_{\max}} \right] z_{i1}, \quad (29)$$

where $\overline{r_i}$ is the final pulse emissivity; $t_{\max}$ is the maximum number of iterations.

(4) Dynamic adaptive update speed

In the basic BA algorithm, the speed update coefficient is constant to 1, resulting in bats cannot dynamically find prey, thereby reducing population diversity Therefore, this paper adopts the following dynamic adaptive speed update method:

$$\omega = \cos\left(\frac{\pi t}{2t_{\max}} + \pi\right) + 1, \quad (30)$$

$$v_i^t = \omega v_i^{t-1} + (x_i^{t-1} - x^*) f_t 1, \quad (31)$$

where, ω is the dynamic speed update coefficient. It can be seen from Equation (30) that w is the dynamic change from 0 to 2, which can further enhance the global optimization ability of bat population.

4.3. Intelligent Evaluation Process Based on CBA-GRNN

Based on the establishment of the evaluation index system and the classical evaluation model, this section proposes the CBA-GRNN intelligent evaluation model, namely, using CBA to optimize GRNN, so as to obtain the optimal value of smoothing factor, and finally obtain the evaluation results and analyze the results. The proposed intelligent evaluation framework is shown in Figure 3. The specific steps are as follows:

1. Initial input variable selection and data preprocessing. Based on the established evaluation index system, the initial input variable set is formed, and the original data of each input factor is quantified and standardized.
2. Initialize the parameters in the CBA algorithm. The population size is set to 40, the maximum number of iterations is 1000, the frequency range is [0,2], the initial loud-ness is 1.0, and the volume attenuation coefficient is 0.95.
3. The smoothing factor of the GRNN model is optimized by the CBA algorithm. The smoothing factor of the GRNN model will have an important impact on its final

evaluation effect, which is related to the accuracy of the sustainable evaluation of innovation and entrepreneurship education in colleges and universities. Therefore, this model uses the CBA algorithm to search for the smoothing factor of the GRNN model. When the number of iterations reaches the maximum, it shows that the best parameters have been obtained. If not close to the maximum number of iterations, the algorithm needs to be rerun to obtain the corresponding optimal solution set. Then the smoothing factor optimized by the CBA algorithm is used to retrain and test GRNN in the test sample set, and this parameter is adjusted again to obtain the optimal intelligent evaluation model of innovation and entrepreneurship education sustainability in colleges and universities.

4. Output intelligent evaluation results and analyze the results. Based on the above-mentioned optimal intelligent evaluation model for the sustainability of innovation and entrepreneurship education in colleges and universities, the simulation carried out, and the obtained intelligent evaluation results are compared with the calculation results of the classical evaluation model.

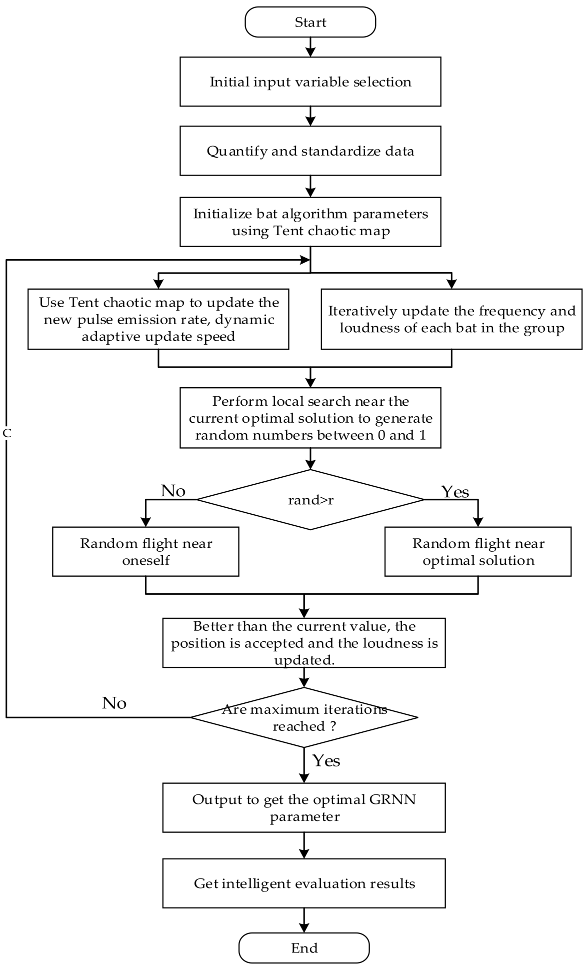

Figure 3. Flow chart of intelligent evaluation.

5. Case Analysis

5.1. Evaluation Index Classification and Data Acquisition

On the basis of constructing the evaluation index system of innovation and entrepreneurship education sustainability of clean energy major in colleges and universities, according to the existing research results and consulting expert opinions, combined with the actual situation of innovation and entrepreneurship education sustainability evaluation index of clean energy major in colleges and universities, the indexes of index layer are further analyzed, and the five-level evaluation criteria of 28 indexes reflecting the sustainability of innovation and entrepreneurship education of clean energy major in colleges and universities are formulated. The types and grading standards of each evaluation index are shown in Table 2.

Table 2. Types and classification criteria of evaluation indicators.

Evaluation Indicators	Types	Level 1	Level 2	Level 3	Level 4	Level 5
C11	Qualitative	60	70	80	90	100
C12	Qualitative	60	70	80	90	100
C21	Qualitative	60	70	80	90	100
C22	Qualitative	60	70	80	90	100
C23	Qualitative	60	70	80	90	100
C33	Qualitative	60	70	80	90	100
I11	Qualitative	60	70	80	90	100
I12	Quantitative	20	30	40	50	70
I13	Quantitative	0.1	0.2	0.3	0.4	0.7
I14	Quantitative	10	30	50	70	90
I21	Quantitative	10	20	30	40	50
I22	Qualitative	60	70	80	90	100
I31	Qualitative	60	70	80	90	100
I32	Qualitative	60	70	80	90	100
I33	Qualitative	60	70	80	90	100
P11	Quantitative	10	20	30	40	50
P12	Quantitative	10	20	30	40	50
P13	Quantitative	10	20	30	40	50
P14	Qualitative	60	70	80	90	100
P21	Qualitative	60	70	80	90	100
P22	Qualitative	60	70	80	90	100
P23	Qualitative	60	70	80	90	100
P31	Quantitative	25	50	70	90	100
P32	Quantitative	20	40	60	80	100
R11	Quantitative	15	30	45	60	75
R12	Qualitative	60	70	80	90	100
R21	Qualitative	60	70	80	90	100
R22	Quantitative	10	25	40	55	70

Level 1 is the low level of sustainable development, which means that the environment, investment, process, and results of clean energy professional innovation and entrepreneurship education in colleges and universities are particularly poor. This will be extremely detrimental to its sustainable development in the long run, and timely improvement measures should be taken. Level 2 is a relatively low level of sustainable development, indicating that the environment, investment, process, and results of the clean energy professional innovation and entrepreneurship education in universities are poor. In the long run, this will have an adverse impact on its sustainable development, and timely improvement measures should be taken. Level 3 is the average level of sustainable development, indicating that the environment, investment, process, and results of the clean energy professional innovation and entrepreneurship education in colleges and universities are average, and the level of sustainable development can continue to be improved. Level 4 is a relatively high level of sustainable development, indicating that the environment, investment, process, and results of innovation and entrepreneurship education for clean energy in colleges and universities have performed well. Innovation and entrepreneurship education has achieved certain results, which can ensure high efficiency and cleanliness to a certain extent the sustainable development of energy innovation and entrepreneurship education, but the level of sustainable development can continue to be improved. Level 5 is a high level of sustainable development, indicating that the environment, investment, process, and results of innovation and entrepreneurship education for clean energy majors in colleges and universities have outstanding performance. Innovation and entrepreneurship education has achieved fruitful results and can ensure sustainable development.

Through field research and data collection, the relevant data of 30 universities are collected and sorted. At the same time, 20 experts are invited to score 30 qualitative indicators according to the interval score, and then these scores are summarized and sorted out to obtain the average value. The data value of each qualitative index of 30 samples can be obtained.

5.2. Sustainability Evaluation of Innovation and Entrepreneurship Education of Clean Energy Major in Colleges and Universities Based on Classical Evaluation Model

5.2.1. Basic Bat Algorithm

According to the evaluation index pretreatment method in Formula (1), the original data of the sustainability evaluation index of innovation and entrepreneurship education in 30 universities are standardized. The processing results are shown in Tables A1–A3. To simplify the paper, Tables A1–A3 will be shown in Appendix A.

According to the weight determination method described in 3.1, the weight of the sustainability evaluation index of innovation and entrepreneurship education in colleges and universities is shown in Table 3.

Table 3. Evaluation index weight calculation results.

Index Number	RO Method Weight	Weight of Entropy Weight Method	Combination Weight	Index Number	RO Method Weight	Weight of Entropy Weight Method	Combination Weight
C11	0.047	0.030	0.048	I33	0.002	0.049	0.004
C12	0.062	0.027	0.057	P11	0.015	0.047	0.024
C21	0.059	0.024	0.047	P12	0.005	0.056	0.009
C22	0.037	0.033	0.042	P13	0.007	0.061	0.015
C23	0.042	0.027	0.039	P14	0.049	0.026	0.043
C33	0.064	0.024	0.053	P21	0.032	0.028	0.031
I11	0.039	0.029	0.039	P22	0.054	0.028	0.051
I12	0.022	0.042	0.031	P23	0.030	0.028	0.028
I13	0.017	0.054	0.031	P31	0.025	0.039	0.033
I14	0.010	0.060	0.020	P32	0.052	0.031	0.054
I21	0.012	0.053	0.022	R11	0.020	0.044	0.030
I22	0.069	0.024	0.056	R12	0.067	0.018	0.041
I31	0.034	0.024	0.028	R21	0.044	0.028	0.043
I32	0.057	0.022	0.042	R22	0.027	0.041	0.038

5.2.2. Evaluation Results Analysis Based on SPA-VFS

According to the Formulas (9)–(13), the connection degree μ_{ijg} between the j sample and the level i under the index is calculated. Taking S1 and S2 as examples, the results are shown in Table A4.

According to Formula (14), the comprehensive connection degree u_{jg} between sample j and evaluation grade g is calculated, and the calculation results are shown in Table A5.

Calculate the relative membership degree between sample A and evaluation grade B according to Formula (15). The calculation results are shown in Table A6. According to Formulas (16) and (17), the eigenvalues and grades of evaluation samples are calculated. The calculation results are shown in Table 4.

Table 4. Eigenvalues and Evaluation Levels of Evaluation Samples.

Samples	Eigenvalues	Grades	Samples	Eigenvalues	Grades
S1	3.2563	3	S16	4.5037	5
S2	4.4815	4	S17	3.3244	3
S3	3.3096	3	S18	3.7034	4
S4	3.1629	3	S19	3.5067	4
S5	3.2473	3	S20	3.2091	3
S6	3.2918	3	S21	3.1557	3
S7	3.2815	3	S22	3.2794	3
S8	1.5499	2	S23	4.4747	4
S9	3.4314	3	S24	4.4795	4
S10	3.1982	3	S25	3.2524	3
S11	3.3574	3	S26	1.5308	2
S12	1.5367	2	S27	4.4924	4
S13	4.5139	5	S28	3.3823	3
S14	3.4967	3	S29	3.3110	3
S15	3.3597	3	S30	3.3878	3

5.3. Sustainability Evaluation of Innovation and Entrepreneurship Education of Clean Energy Major in Colleges and Universities Based on Intelligent Evaluation Model

By applying the classical evaluation model based on the combination entropy weight rank method and SPA-VFS, the objective and accurate evaluation results and grades of the sustainable development level of innovation and entrepreneurship education of clean energy major in 30 sample universities are obtained. However, through the calculation process, it can be found that the calculation of the model is complex, the efficiency is low, and the workload is large. When faced with massive sample data, the method is inevitably difficult to quickly and effectively calculate the evaluation results and grades. Therefore, this paper will further use the constructed intelligent evaluation model to evaluate the 30 samples. On this basis, the intelligent evaluation results are compared with the evaluation results in the previous section to verify the effectiveness of the intelligent evaluation model. This section continues to use the data of the above 30 sample universities for empirical analysis. The data of the first 20 samples are used as training samples, and the data of the last 10 samples are used as test samples.

The experimental and modeling platform of this paper is Matlab R2014a, and the operating environment is Intel Core i5-6300U, 4 G memory, and 500 G hard disk. The self-written program is used for operation and calculation in Matlab software. It is worth noting that the important parameters of the model proposed in this paper are optimized by the CBA algorithm to ensure the accuracy and accuracy of the prediction model. The smoothing factor of the GRNN model calculated by running the program is 0.0026.

To verify the performance of the intelligent evaluation model proposed in this paper, based on the sample data, this paper uses CBA-GRNN, BA-GRNN, GRNN, BPNN, and SVM for comparative experiments. The smoothing factor of the single GRNN model is 0.16. The hidden layer transfer function of the BPNN model adopts tansig function, and the output layer transfer function adopts purelin function. The maximum training number is 200, the minimum error of training target is 0.0001, and the training rate is 0.1. The initial weights and thresholds are obtained by their own training. In SVM, the penalty parameter c is 9.689, the kernel function parameter is 0.0066, and the loss function parameter p is 3.2686.

The eigenvalues and evaluation levels of test samples obtained by intelligent calculation are shown in Tables 5 and 6. To make the comparison clearer, draw the comparison chart as shown in Figures 4–6.

Table 5. Eigenvalue comparison.

Samples	Classic Evaluation Results	CBA-GRNN		BA-GRNN		GRNN		BPNN		SVM	
		Evaluation Result	Relative Error	Evaluation Result	Relative Error	Evaluation Result	Relative Error	Evaluation Result	Relative Error	Evaluation Result	Relative Error
S21	3.1557	3.0828	−2.31%	3.0393	−3.69%	3.3306	5.54%	3.3981	7.68%	2.9462	−6.64%
S22	3.2794	3.3846	3.21%	3.1144	−5.03%	3.1469	−4.04%	3.1308	−4.53%	3.0423	−7.23%
S23	4.4747	4.3713	−2.31%	4.2254	−5.57%	4.6563	4.06%	4.0827	−8.76%	4.6899	4.81%
S24	4.4795	4.3635	−2.59%	4.3607	−2.65%	4.7979	7.11%	4.6703	4.26%	4.7868	6.86%
S25	3.2524	3.2338	−0.57%	3.3955	4.40%	3.3685	3.57%	3.4056	4.71%	3.0107	−7.43%
S26	1.5308	1.5837	3.46%	1.4349	−6.26%	1.6326	6.65%	1.4515	−5.18%	1.6295	6.45%
S27	4.4924	4.5625	1.56%	4.2610	−5.15%	4.2799	−4.73%	4.8859	8.76%	4.7804	6.41%
S28	3.3823	3.4638	2.41%	3.5653	5.41%	3.2260	−4.62%	3.6252	7.18%	3.6752	8.66%
S29	3.3110	3.2289	−2.48%	3.4676	4.73%	3.4898	5.40%	3.0537	−7.77%	3.4663	4.69%
S30	3.3878	3.3207	−1.98%	3.1903	−5.83%	3.6087	6.52%	3.5992	6.24%	3.5562	4.97%

Table 6. Evaluation grade comparison.

Samples	Classic Evaluation Results	CBA-GRNN	BA-GRNN	GRNN	BPNN	SVM
S21	3	3	3	3	3	3
S22	3	3	3	3	3	3
S23	4	4	4	5	4	5
S24	4	4	4	5	5	5
S25	3	3	3	3	3	3
S26	2	2	1	2	1	2
S27	4	5	4	4	5	5
S28	3	3	4	3	4	4
S29	3	3	3	3	3	3
S30	3	3	3	4	4	4
relative error	-	10%	20%	30%	50%	50%

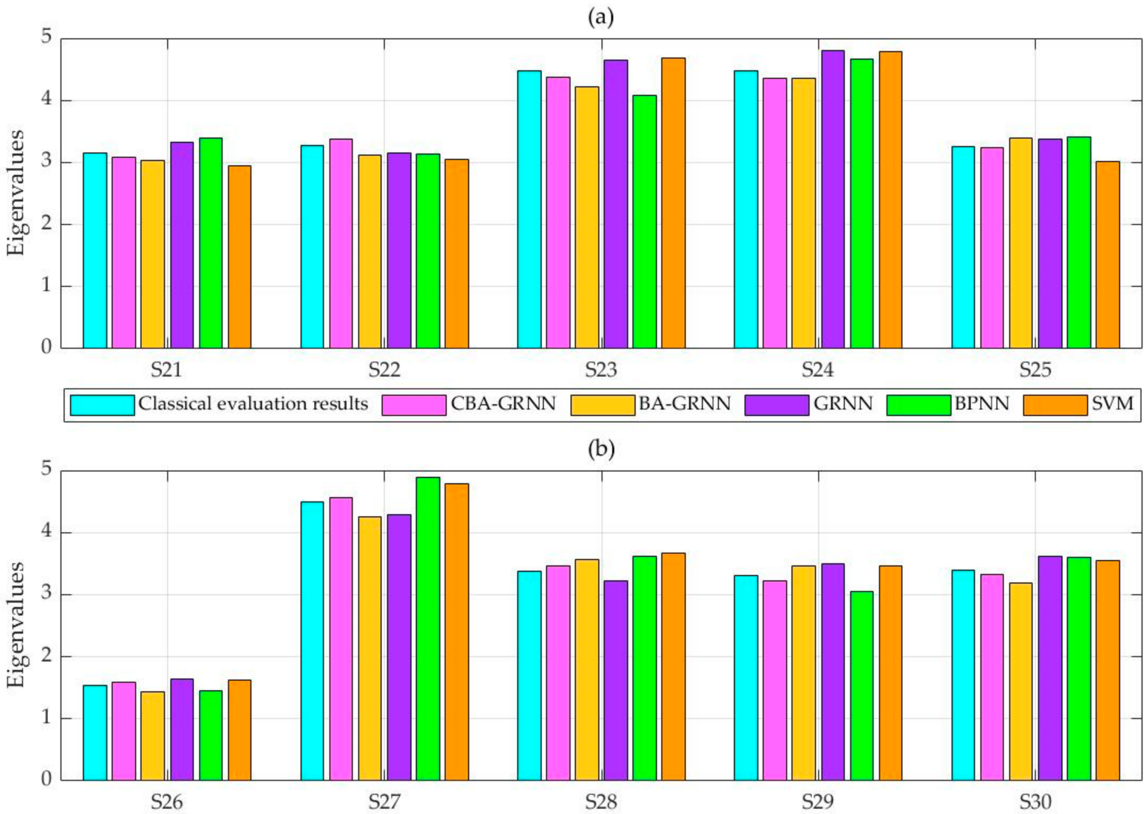

Figure 4. Comparison of eigenvalues of test samples. Note: (**a**) shows the results from sample S21 to S25; (**b**) shows the results from sample S26 to S30.

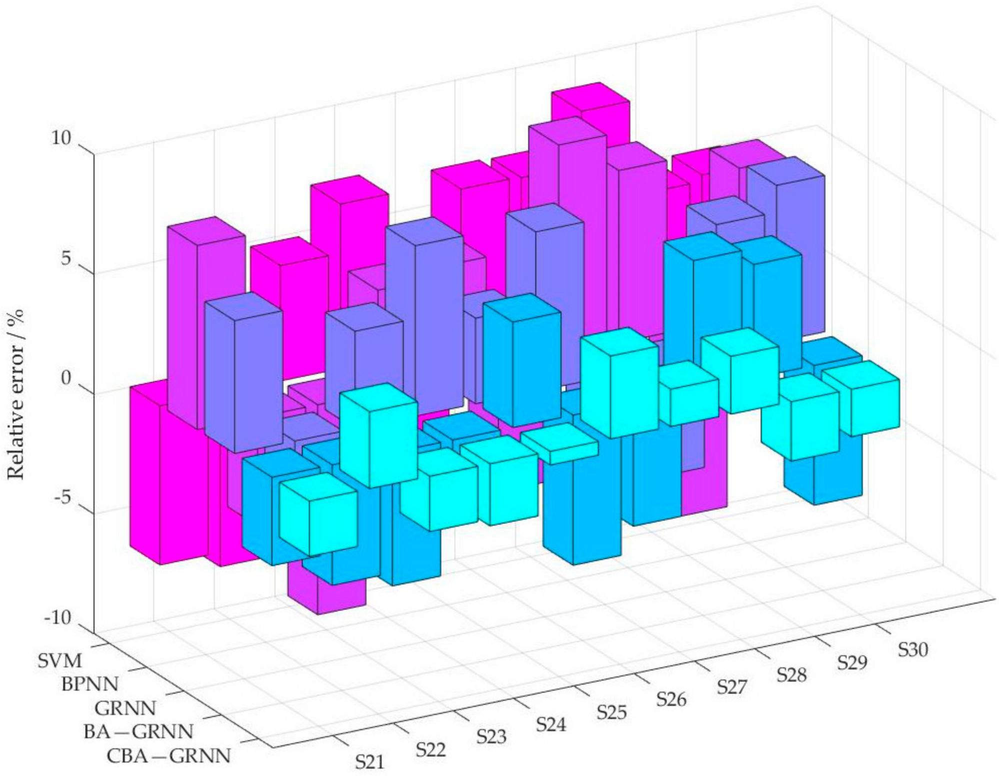

Figure 5. Relative error of eigenvalues calculation of test sample.

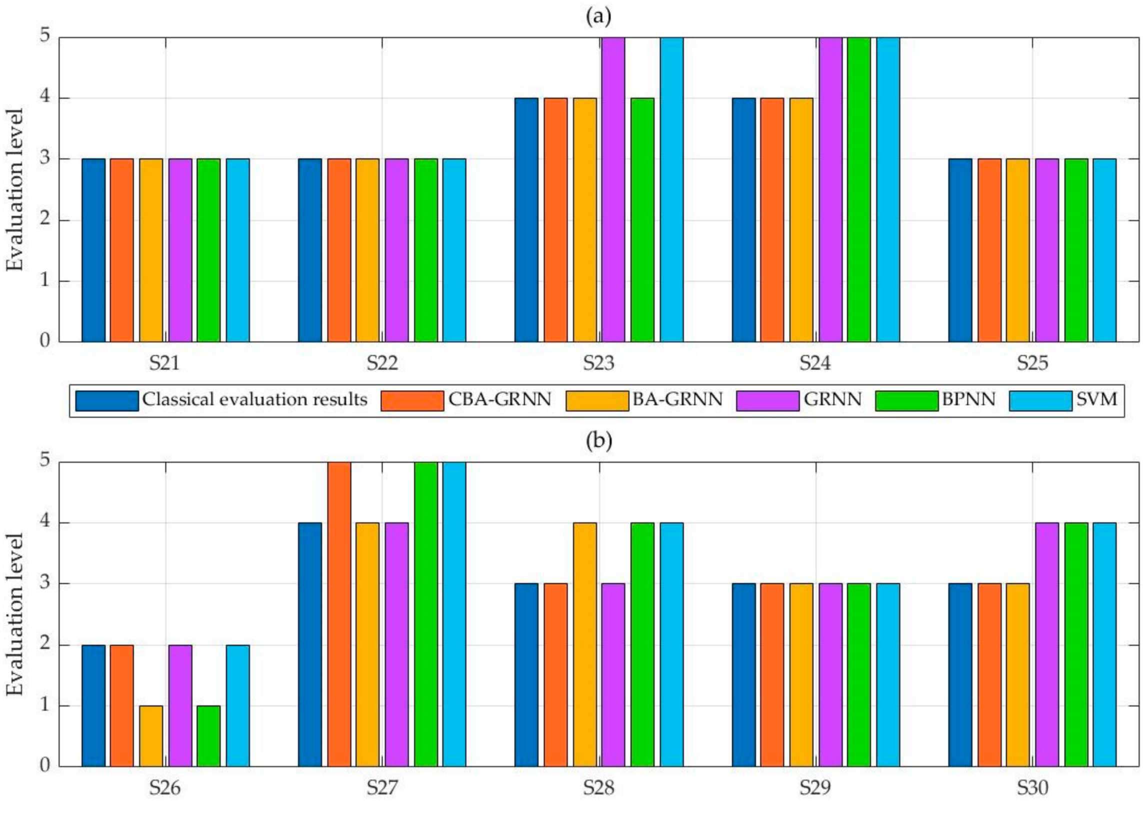

Figure 6. Comparison of evaluation levels of test samples. Note: (**a**) shows the results from sample S21 to S25; (**b**) shows the results from sample S26 to S30.

From the above comparison results, whether it is the eigenvalue calculation results or the evaluation grade calculation results, the CBA-GRNN model is used to calculate the sustainability evaluation results of innovation and entrepreneurship education of clean energy major in colleges and universities. The results of the proposed model are closest to the classical evaluation results based on SPA-VFS, and its relative error is also the smallest, followed by BA-GRNN, GRNN, BPNN, and SVM.

6. Conclusions and Discussion

The sustainable development of innovation and entrepreneurship education for clean energy major in colleges and universities can provide more excellent innovative talents for the clean energy industry, and can also provide a reference for the development of innovation and entrepreneurship education for other majors. Therefore, the healthy and sustainable development of innovation and entrepreneurship education of clean energy specialty in colleges and universities, this paper designs a set of sustainable evaluation system of innovation and entrepreneurship education of clean energy specialty in colleges and universities, including a set of evaluation index system and a new hybrid evaluation method. Firstly, the sustainability evaluation index system of innovation and entrepreneurship education for clean energy major in colleges and universities is constructed from four aspects of the environment, investment, process, and results of innovation and entrepreneurship education for clean energy major in colleges and universities, which solves the problems in which the sustainability of innovation and entrepreneurship education for clean energy majors in colleges and universities is mainly reflected. Then, the weight of the evaluation index is obtained based on the combination entropy weight rank method, and the SPA-VFS evaluation model is designed, and the evaluation results are obtained from the perspective of classical evaluation methods. Then, the basic bat algorithm is improved by using Tent chaotic mapping to form a new CBA, and the intelligent evaluation model is constructed by using CBA to optimize GRNN. The scientificity and accuracy of the proposed evaluation model are verified by example analysis. The classical evaluation model can obtain accurate reference results, while the modern intelligent evaluation model can achieve the purpose of fast calculation and support related decisions. The main conclusions are summarized as follows:

(1) The evaluation index system constructed from four aspects of environment, investment, process and result helps us understand what aspects of the sustainability of innovation and entrepreneurship education for clean energy majors in colleges and universities, and provides a basis for calculation for subsequent evaluation.
(2) According to the analysis of the actual situation, the sustainability evaluation model of innovation and entrepreneurship education for clean energy majors in colleges and universities based on the combination entropy weight rank method and SPA-VFS constructed in this paper objectively and truly reflects the sustainable development level of innovation and entrepreneurship education for clean energy majors in 30 sample colleges and universities. It also has certain reference significance for the evaluation of the sustainable development level of innovation and entrepreneurship education for clean energy majors in other colleges and universities.
(3) The error of the evaluation results of the CBA-GRNN model is small, and the overall accuracy of the classification is the highest. Compared with the BA-GRNN model, the optimization performance of the GRNN model is better after the BA algorithm is improved by Tent chaotic mapping. Compared with the GRNN model, the parameters of GRNN can be optimized by the BA algorithm to improve its generalization ability and classification accuracy. Compared with the BPNN model and SVM model, the GRNN model has fewer adjustment parameters, is not easy to fall into a local minimum, and is good at dealing with large-scale training samples, thus greatly improving the accuracy of evaluation.

In summary, the research results of this paper can provide a decision-making basis for proposing a more sustainable and healthy innovation and entrepreneurship education model for clean energy major in colleges and universities. In future research, more intelligent models can be utilized for evaluation to obtain more accurate evaluation results. Furthermore, research on the sustainability evaluation of innovation and entrepreneurship education for clean energy majors in colleges and universities in other educational models can be continued.

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Appendix A

Table A1. Standardized data processing results of sustainability evaluation index of innovation and entrepreneurship education in colleges and universities (S1–S10).

Indexes	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
C11	0.9859	0.9155	0.8310	0.7465	0.4225	0.6338	0.3803	0.0423	0.0986	0.6197
C12	0.5873	0.9524	0.2222	0.8254	0.7937	1.0000	0.6667	0.0476	0.8571	0.7143
C21	0.2712	0.9492	0.7119	0.6610	0.7966	0.8475	0.8136	0.0339	1.0000	0.5254
C22	0.6429	0.9286	0.0000	0.3810	0.5952	0.0238	0.8095	0.0714	0.5238	0.9524
C23	0.8600	0.8800	0.7800	0.7000	0.6600	0.7600	0.2200	0.1000	0.8400	0.0000
C33	0.0000	0.9583	0.7917	0.8611	0.5556	0.6667	0.9028	0.0417	0.7083	0.6250
I11	0.7250	0.8500	0.5750	0.0000	0.7000	0.7000	0.0000	0.0750	0.7750	0.4250
I12	0.0833	0.9833	0.9000	0.6667	0.0000	0.5833	0.5167	0.0167	0.6000	0.6667
I13	0.5902	0.9836	0.4918	0.3770	0.8689	0.4262	0.5082	0.0164	0.4590	0.3115
I14	0.7143	0.9429	0.0000	0.1286	0.4286	0.0286	0.1143	0.0714	0.1286	0.5143
I21	0.5476	0.9762	0.1667	0.2143	0.2143	0.0714	0.8333	0.0714	0.5952	0.2619
I22	0.9474	0.9649	0.8421	0.2982	0.5965	0.7018	0.9123	0.0877	0.8947	0.8421
I31	0.4615	0.9744	0.4615	0.0000	0.6667	0.8462	0.4103	0.1026	0.6667	0.4103
I32	0.0000	0.9750	0.9250	0.5750	0.6250	0.5250	0.6000	0.1250	0.7500	0.7750
I33	0.4000	0.5600	0.6000	0.2400	0.6800	0.4800	0.2000	0.1600	0.5200	0.0400
P11	0.5250	1.0000	0.4750	0.1500	0.1500	0.4250	0.6750	0.0750	0.5250	1.0000
P12	0.2500	0.9500	0.2750	0.0750	0.5000	0.0000	0.3500	0.1000	0.5000	0.5250
P13	0.5349	0.9535	0.4419	0.6047	0.0698	0.6512	0.0233	0.1163	0.2326	0.5581
P14	0.7222	1.0000	0.7500	0.9167	0.8333	0.9444	0.4167	0.0278	0.6667	0.5278
P21	0.4318	0.9091	0.7045	0.6364	0.8182	0.6591	0.0682	0.0682	0.6591	0.6364
P22	1.0000	0.8718	0.9744	0.8462	0.8205	0.9231	0.5897	0.0513	0.6410	0.0000
P23	0.6829	0.9024	0.4390	0.4878	0.5122	0.3659	0.8293	0.0488	0.5610	1.0000
P31	0.0000	0.9286	0.9762	0.1190	0.5952	0.6905	0.6905	0.0952	0.9762	0.4762
P32	0.0972	0.9306	0.6250	0.6528	0.7639	0.9444	0.8611	0.0694	0.0000	0.6667
R11	0.9070	0.8837	0.6047	0.2093	0.0000	0.4419	0.4186	0.0233	0.6744	0.6279
R12	0.7069	0.8966	0.7414	0.7931	0.5517	0.5690	0.8966	0.0517	0.5690	0.7069
R21	0.8500	0.8750	0.0000	0.6000	0.7250	0.1000	0.7250	0.0250	0.8000	0.5250
R22	0.8636	0.9318	0.2727	0.6591	0.7727	0.8182	0.5682	0.1136	0.9091	0.9091

Table A2. Results of standardized data processing on sustainability evaluation index of innovation and entrepreneurship education in colleges and universities (S11–S20).

Indexes	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
C11	0.7746	0.0282	0.9718	0.8592	0.6056	1.0000	0.8451	0.9437	0.8310	0.0000
C12	0.6984	0.0317	0.9683	0.8254	0.7143	0.9841	0.5873	0.8095	0.5873	0.6667
C21	0.5593	0.0000	0.9322	0.3220	0.7288	0.9322	0.7797	0.4915	0.7627	0.7119
C22	0.7857	0.0714	0.8571	0.7619	0.9524	0.9048	0.5238	0.7857	0.9524	0.6905
C23	0.7600	0.0800	0.9000	0.5400	1.0000	0.9200	0.7400	0.9600	0.6000	0.6400
C33	0.6667	0.0417	0.9583	0.7361	0.9722	0.9306	0.6806	1.0000	0.8333	0.6528
I11	0.6250	0.1000	0.9500	0.5500	0.5250	0.9000	0.8500	1.0000	0.6000	0.7750
I12	1.0000	0.0667	0.9667	0.8667	0.4167	0.9500	0.6167	0.0000	0.4167	0.7167
I13	0.0000	0.0164	0.9836	0.5738	0.0984	0.9836	0.9836	0.1148	0.2951	0.1803
I14	1.0000	0.0143	0.9143	0.8429	0.0000	0.9857	0.4714	0.8571	0.4429	0.4714
I21	0.1190	0.0238	0.9524	0.6190	0.2857	0.8810	0.9048	0.0000	1.0000	0.0714
I22	0.0000	0.0877	0.9825	0.8070	0.6140	0.9474	0.7544	1.0000	0.8596	0.6667
I31	0.5897	0.0256	0.9231	0.7179	0.6154	1.0000	0.6923	0.5897	0.8462	0.5641
I32	1.0000	0.0750	0.9000	0.5750	0.8250	0.9750	0.6750	0.6750	0.9000	0.6750
I33	0.2800	0.0400	0.6800	0.0000	0.0400	1.0000	0.2400	0.7200	0.4400	0.5600
P11	0.6750	0.0500	0.9750	0.5500	0.3750	0.9750	0.6250	0.0000	0.3000	0.0750
P12	0.3750	0.0250	0.9750	0.5250	0.2250	0.8750	1.0000	0.1500	0.0000	0.0750
P13	0.4419	0.1163	0.9070	0.3721	0.4651	0.9767	0.0930	0.2558	0.5349	0.0233
P14	0.6111	0.0556	0.9444	0.8889	0.5278	0.9444	0.4167	0.6944	0.8611	0.8611
P21	0.6364	0.0455	0.8864	0.5682	0.6591	0.9545	0.6818	0.7955	0.5000	1.0000
P22	0.6923	0.0513	0.9487	0.7692	0.6154	0.8462	0.5641	0.9744	0.4872	0.5385
P23	0.8049	0.0976	0.9756	0.3659	0.6341	0.8780	0.0000	0.7805	0.5366	0.7317
P31	0.7619	0.0952	0.9524	0.6667	0.4762	0.9048	0.1190	0.7143	0.7381	1.0000
P32	0.5278	0.0556	0.9861	0.4444	0.5833	1.0000	0.9722	0.7083	0.9861	0.8750
R11	0.2791	0.0930	0.8837	0.4651	1.0000	0.9070	0.1395	0.4651	0.8837	0.9070
R12	0.8103	0.0000	0.9310	0.6724	0.8103	0.9310	0.6034	0.8103	0.5517	0.6034
R21	0.8250	0.0500	0.9750	0.4750	0.5250	0.9250	0.4750	0.9250	0.9250	0.6750
R22	0.4318	0.0909	0.9091	0.9773	1.0000	0.9545	0.7727	0.6364	0.2500	0.1591

Table A3. Results of standardized data processing on sustainability evaluation index of innovation and entrepreneurship education in colleges and universities (S21–S30).

Indexes	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30
C11	0.7324	0.6197	0.9296	0.9155	0.6479	0.0423	0.9859	0.7183	0.6056	0.8732
C12	0.0000	0.5397	0.9683	0.9365	0.9365	0.0159	0.9683	0.9365	0.7937	0.6825
C21	0.6610	0.5424	0.9492	0.9322	0.7119	0.0169	0.9153	1.0000	0.7458	0.9831
C22	0.6429	1.0000	0.9524	0.9286	0.0714	0.1190	0.9762	0.6429	0.5714	0.6667
C23	0.7400	0.7200	0.9200	0.8800	0.2800	0.1000	0.9800	0.1600	0.6200	0.7400
C33	0.6250	0.4583	0.9167	0.9583	0.6528	0.0556	0.9306	1.0000	0.6944	0.6389
I11	0.5500	0.8750	0.8750	0.8500	0.6750	0.0500	0.8750	0.6000	1.0000	0.7750
I12	0.4167	0.5500	0.9833	0.9000	0.5500	0.0500	0.9000	0.6000	0.2167	0.4333
I13	0.5574	0.2787	0.9836	0.9836	0.3443	0.0164	0.9836	0.4918	0.0492	1.0000
I14	0.5857	0.6143	0.9857	0.9714	0.3857	0.0143	0.9429	0.3143	0.3429	0.1714
I21	0.5238	0.6905	0.9762	0.9524	0.6905	0.0476	0.8810	0.5952	0.4048	0.1905
I22	0.7544	0.9123	0.9649	0.8947	0.7368	0.0175	0.9298	1.0000	0.9123	0.5965
I31	0.7949	0.6154	0.9487	0.9487	0.6923	0.1026	0.9744	0.6667	0.7179	0.5897
I32	0.6500	0.5250	0.8500	0.8750	1.0000	0.0500	0.9250	0.7250	0.7500	0.7750
I33	0.0800	0.0000	0.5200	0.6800	0.4800	0.1600	0.6400	0.1600	0.7200	0.3200
P11	0.4250	0.2250	0.9250	1.0000	0.0250	0.0750	0.9250	0.5750	0.3750	0.6250
P12	0.4250	0.4500	0.8750	0.9500	0.4500	0.0750	0.9500	0.2750	0.2000	0.3500
P13	0.0000	0.3488	0.9767	0.9070	0.1163	0.0930	0.9535	1.0000	0.2326	0.0233
P14	0.0000	0.8611	0.9167	1.0000	0.5833	0.1111	0.9722	0.4444	0.7778	0.4722
P21	0.6136	0.5000	0.9545	0.8636	0.7955	0.0682	0.9091	0.0000	0.6136	0.5455
P22	0.8718	0.7179	0.9231	0.9231	0.8462	0.0513	0.9487	0.1026	0.7692	0.5897
P23	0.4146	0.4390	0.9024	0.9268	0.4146	0.0732	0.9024	0.9024	0.3659	0.8293
P31	0.5238	0.3810	0.9524	0.9048	0.3095	0.0714	0.9286	0.0000	0.5238	0.6905
P32	0.3056	0.5556	0.9722	0.9861	0.9583	0.0278	0.9444	0.9028	0.9028	0.5278
R11	0.4419	0.9302	0.8605	0.9535	0.5349	0.0233	0.9302	0.0698	0.0698	0.5581
R12	0.8276	0.7586	0.9138	0.9483	0.8448	0.0517	0.9310	1.0000	0.7241	0.7759
R21	0.5750	0.9500	0.8750	0.9250	0.4750	0.1250	0.8500	0.8750	0.8500	1.0000
R22	0.6364	0.2273	0.9773	0.9091	0.4545	0.0909	0.8636	0.0909	0.0000	0.0227

Table A4. Calculation results of connection degree between samples S1, S2 and grades.

Indexes	S1					S2				
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 1	Level 2	Level 3	Level 4	Level 5
C11	−1.00	−1.00	−1.00	−0.60	1.00	−1.00	−1.00	−1.00	0.40	1.00
C12	−1.00	0.40	1.00	−0.40	−1.00	−1.00	−1.00	−1.00	−0.20	1.00
C21	1.00	0.83	−1.00	−1.00	−1.00	−1.00	−1.00	−1.00	0.00	1.00
C22	−1.00	−1.00	0.60	1.00	−0.60	−1.00	−1.00	−1.00	0.20	1.00
C23	−1.00	−1.00	−1.00	1.00	1.00	−1.00	−1.00	−1.00	0.80	1.00
C33	1.00	−0.17	−1.00	−1.00	−1.00	−1.00	−1.00	−1.00	0.20	1.00
I11	−1.00	−1.00	0.20	1.00	−0.20	−1.00	−1.00	−0.80	1.00	0.80
I12	1.00	0.00	−1.00	−1.00	−1.00	−1.00	−1.00	−1.00	−0.40	1.00
I13	−1.00	−1.00	−1.00	0.93	1.00	−1.00	−1.00	−1.00	−0.67	1.00
I14	−1.00	−1.00	0.40	1.00	−0.40	−1.00	−1.00	−1.00	0.80	1.00
I21	−1.00	−1.00	0.80	1.00	−0.80	−1.00	−1.00	−1.00	−0.80	1.00
I22	−1.00	−1.00	−1.00	0.60	1.00	−1.00	−1.00	−1.00	0.40	1.00
I31	−1.00	0.40	1.00	−0.40	−1.00	−1.00	−1.00	−1.00	0.40	1.00
I32	1.00	0.73	−1.00	−1.00	−1.00	−1.00	−1.00	−1.00	0.80	1.00
I33	−1.00	−1.00	0.80	1.00	−0.80	−1.00	−1.00	0.00	1.00	0.00
P11	−1.00	0.20	1.00	−0.20	−1.00	−1.00	−1.00	−1.00	0.40	1.00
P12	−0.20	1.00	0.20	−1.00	−1.00	−1.00	−1.00	−1.00	0.20	1.00
P13	−1.00	0.00	1.00	0.00	−1.00	−1.00	−1.00	−1.00	0.40	1.00
P14	−1.00	−1.00	0.80	1.00	−0.80	−1.00	−1.00	−1.00	0.80	1.00
P21	−1.00	0.80	1.00	−0.80	−1.00	−1.00	−1.00	−1.00	0.60	1.00
P22	−1.00	−1.00	−1.00	0.80	1.00	−1.00	−1.00	−0.20	1.00	0.20
P23	−1.00	−1.00	0.40	1.00	−0.40	−1.00	−1.00	−1.00	0.60	1.00
P31	−1.00	0.40	1.00	−0.40	−1.00	−1.00	−1.00	−1.00	0.00	1.00
P32	−0.50	1.00	0.50	−1.00	−1.00	−1.00	−1.00	−1.00	−0.50	1.00
R11	−1.00	−1.00	1.00	1.00	−1.00	−1.00	−0.87	1.00	0.87	−1.00
R12	−1.00	−0.80	1.00	0.80	−1.00	−1.00	−1.00	−1.00	1.00	1.00
R21	−1.00	−1.00	−0.20	1.00	0.20	−1.00	−1.00	−0.40	1.00	0.40
R22	−1.00	−1.00	0.47	1.00	−0.47	−1.00	−1.00	0.07	1.00	−0.07

Table A5. Calculation results of the comprehensive connection degree (CCD).

Sample	Level 1 CCD	Level 2 CCD	Level 3 CCD	Level 4 CCD	Level 5 CCD
S1	−0.6184	−0.3644	0.0055	0.1410	−0.3871
S2	−1.0000	−0.9960	−0.8215	0.3919	0.8215
S3	−0.6140	−0.3803	−0.0550	0.2529	−0.3311
S4	−0.5838	−0.2966	0.1269	0.2694	−0.5431
S5	−0.6383	−0.4056	0.1275	0.2458	−0.4892
S6	−0.7134	−0.2970	0.0634	0.0799	−0.3500
S7	−0.6006	−0.2630	−0.1388	0.1516	−0.2606
S8	0.8440	0.5493	−0.8440	−0.9631	−1.0000
S9	−0.7845	−0.4973	0.1576	0.3361	−0.3731
S10	−0.8153	−0.1705	0.3566	0.0507	−0.5413
S11	−0.7469	−0.4751	0.2065	0.3269	−0.4597
S12	0.8609	0.5336	−0.8609	−0.9656	−1.0000
S13	−1.0000	−0.9960	−0.8578	0.3190	0.8578
S14	−0.8837	−0.4733	0.2409	0.4482	−0.3572
S15	−0.8848	−0.3552	0.3527	0.1906	−0.4679
S16	−1.0000	−1.0000	−0.8366	0.3217	0.8366
S17	−0.8542	−0.3606	0.3469	0.1438	−0.4927
S18	−0.7247	−0.6189	−0.3898	0.2740	0.1145
S19	−0.9170	−0.3742	0.1464	0.1776	−0.2294
S20	−0.6821	−0.3726	0.2227	0.1300	−0.5406
S21	−0.7489	−0.3088	0.4624	0.2312	−0.7135
S22	−0.8015	−0.2440	0.2661	0.1822	−0.4645
S23	−1.0000	−0.9921	−0.8084	0.3650	0.8084
S24	−1.0000	−1.0000	−0.8280	0.4536	0.8280
S25	−0.7651	−0.2877	0.2358	0.0806	−0.4707
S26	0.8718	0.5390	−0.8718	−0.9664	−1.0000
S27	−1.0000	−1.0000	−0.8337	0.3863	0.8337
S28	−0.6135	−0.4459	−0.2323	−0.0089	−0.1543
S29	−0.6941	−0.4290	0.1322	0.2459	−0.4381
S30	−0.8519	−0.3564	0.2289	0.1747	−0.3771

Table A6. Calculation results of relative membership degree (RMD).

Sample	Level 1 RMD	Level 2 RMD	Level 3 RMD	Level 4 RMD	Level 5 RMD
S1	0.1908	0.3178	0.5027	0.5705	0.3064
S2	0.0000	0.0020	0.0893	0.6960	0.9107
S3	0.1930	0.3099	0.4725	0.6265	0.3345
S4	0.2081	0.3517	0.5635	0.6347	0.2284
S5	0.1809	0.2972	0.5638	0.6229	0.2554
S6	0.1433	0.3515	0.5317	0.5400	0.3250
S7	0.1997	0.3685	0.4306	0.5758	0.3697
S8	0.9220	0.7746	0.0780	0.0184	0.0000
S9	0.1078	0.2513	0.5788	0.6681	0.3134
S10	0.0923	0.4148	0.6783	0.5254	0.2294
S11	0.1266	0.2624	0.6033	0.6635	0.2702
S12	0.9304	0.7668	0.0696	0.0172	0.0000
S13	0.0000	0.0020	0.0711	0.6595	0.9289
S14	0.0582	0.2634	0.6204	0.7241	0.3214
S15	0.0576	0.3224	0.6764	0.5953	0.2660
S16	0.0000	0.0000	0.0817	0.6609	0.9183
S17	0.0729	0.3197	0.6735	0.5719	0.2536
S18	0.1377	0.1906	0.3051	0.6370	0.5572
S19	0.0415	0.3129	0.5732	0.5888	0.3853
S20	0.1590	0.3137	0.6113	0.5650	0.2297
S21	0.1255	0.3456	0.7312	0.6156	0.1433
S22	0.0992	0.3780	0.6330	0.5911	0.2677
S23	0.0000	0.0040	0.0958	0.6825	0.9042
S24	0.0000	0.0000	0.0860	0.7268	0.9140
S25	0.1174	0.3561	0.6179	0.5403	0.2646
S26	0.9359	0.7695	0.0641	0.0168	0.0000
S27	0.0000	0.0000	0.0832	0.6932	0.9168
S28	0.1933	0.2770	0.3839	0.4956	0.4229
S29	0.1529	0.2855	0.5661	0.6230	0.2810
S30	0.0741	0.3218	0.6145	0.5873	0.3115

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