

Empirical Research on Innovation and Entrepreneurship Education and Cultural Confidence of College Students Based on Fuzzy Logic and Decision Tree Algorithm

Zhen Xia¹, 

¹ School of Digital Economy & Trade, Wenzhou Polytechnic, Wenzhou, Zhejiang, 325035, China

ABSTRACT

Under the background of globalization and knowledge economy, the importance of innovation and entrepreneurship education for college students is becoming more and more prominent. This paper combines fuzzy logic and decision tree algorithm to construct a cultural confidence recognition model of innovation and entrepreneurship education. Feature selection and classification are carried out on the salient features of the collected data information on innovation and entrepreneurship education. First, eight types of statistical features, such as the degree of integration of excellent traditional culture, the degree of value leadership and moral cultivation, the innovative power of grounded cultural knowledge, and the effect of social responsibility cultivation, are extracted as inputs to the C4.5 algorithm, and a decision tree is constructed for feature selection. Then, according to the constructed decision tree, the affiliation function and IF-THEN rule of the fuzzy inference model are designed. Finally, the designed fuzzy inference model is used to classify the degree of cultural confidence. The method achieves 100% accuracy in recognizing the lack of cultural self-confidence in innovation and entrepreneurship education, and more than 90% in recognizing the overall effect of general cultural self-confidence and rich cultural self-confidence. The experimental results show that the combination of decision tree and fuzzy inference modeling is feasible for the detection and classification of college students' innovation and entrepreneurship education, and has strong practical application value.

Keywords: Fuzzy logic, C4.5 algorithm, IF-THEN rule, innovative entrepreneurship education

1. Introduction

As China's strategy of cultural power continues to advance, higher demands are being placed on society as a whole to build cultural self-confidence. Colleges and universities should firmly regard the cultural self-confidence of college students as one of the important educational tasks, combine the current upsurge of "mass entrepreneurship and innovation", build diversified and personalized

 Corresponding author.

E-mail address: kp12_666@163.com (Z. Xia).

Received 03 March 2024; Revised 20 April 2024; Accepted 10 November 2024; Published Online 15 April 2025.

DOI: [10.61091/jcmcc127a-359](https://doi.org/10.61091/jcmcc127a-359)

© 2025 The Author(s). Published by Combinatorial Press. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>).

teaching methods in innovation and entrepreneurship education, guide young students to actively practice the core values of socialism in the process of innovation and entrepreneurship practice, strengthen cultural self-confidence, resonate with the motherland, and continuously promote the construction of China's socialist cultural power [1-5].

The concept of cultural self-confidence is integrated into innovation and entrepreneurship education, which can further build a strong education country on the basis of enhancing the height of education [6-7]. In the age of informationization, innovation and entrepreneurship education for college students ushers in new development opportunities, but also needs to face multiple challenges at the same time [8]. After several years of practice and exploration, colleges and universities around the world have taken the initiative to cultivate a number of high-quality technical skills and innovative talents, and also incubated a large number of high-quality and effective entrepreneurial projects with the help of "Internet +" Innovation and Entrepreneurship Competition for College Students, showing the spirit of the current generation of college students who have the ideals, commitment and competence [9-12]. Therefore, when colleges and universities practice the path and exploration of innovation and entrepreneurship education, they try to integrate the education of cultural self-confidence, which is conducive to cultivating a high degree of cultural self-awareness and cultural self-confidence among college students [13-14]. By telling the Chinese story and providing Chinese wisdom to the world, it promotes young students to practice socialist core values in innovation and entrepreneurship education, and gradually makes the essence of Chinese excellent traditional culture rooted in the outlook on life, values and worldview of young students, so that they can develop and sublimate the connotations and values of Chinese excellent traditional culture in innovation and entrepreneurship practice [15-19]. Delivering the power of China, telling the story of China, and shaping the Chinese brand for the country, these are of great significance and value for firming the cultural self-confidence of young college students.

In this paper, we adopt a method based on the combination of C4.5 algorithm and fuzzy inference model in decision tree to identify the degree of cultural confidence in innovation and entrepreneurship education. Eight categories of statistical features are extracted as inputs to the C4.5 algorithm to construct a decision tree. The decision tree output is used to generate clear and concise IF-THEN rules according to the decision tree output. The constructed fuzzy inference model is used to identify the three categories of college students' innovation and entrepreneurship education with rich cultural confidence, average cultural confidence, and lack of cultural confidence. Based on the identification results, the effect of innovation and entrepreneurship education is judged, and rectification strategies are proposed to further promote the integration of innovation and entrepreneurship education and cultural self-confidence.

2. Innovation and Entrepreneurship Education and Cultural Confidence

Cultural self-confidence is the full affirmation and active practice of a nation or a country of its own cultural values, as well as firm confidence in the vitality of its culture. Chinese culture has been accumulated for centuries and is so profound that it has become an important spiritual pursuit of the Chinese nation. Students in colleges and universities, who will become the pillars of the motherland in the future, must be baptized by traditional Chinese culture and have high quality. Cultural self-confidence is not a matter of one person, but a matter of a nation, which requires the joint efforts of every Chinese person. Insisting on cultural self-confidence in innovation and entrepreneurship is not only a kind of inheritance of the traditional culture of the Chinese nation, but most importantly, it can also promote cultural self-confidence. Cultural self-confidence can strengthen the innovation and entrepreneurship ability of students, and at the same time, the stronger the entrepreneurial ability of students can also strengthen the cultural self-confidence of the nation [20]. Cultural self-confidence is related to the development of the motherland, innovation and entrepreneurship is also related to the

development of the motherland, it is very important and necessary to integrate cultural self-confidence in innovation and entrepreneurship.

2.1. The role of cultural confidence in the education of innovation and entrepreneurship in colleges and universities

2.1.1. Favorable to establish entrepreneurial orientation and inherit the Chinese spirit. At present, China's innovation and entrepreneurship education in the past development, mostly focuses on the actual skills and practical education, and the ideological and theoretical education is a little bit insufficient. Under such an innovation and entrepreneurship education model, learners can improve their knowledge and skills, but they lack the inheritance of the national spirit, which is a "lighthouse" for us to carry out innovation and entrepreneurship activities, and can play a clear guidance role for the innovation and entrepreneurship behaviors of contemporary college students. Therefore, without a considerable degree of cultural self-confidence, it is difficult for contemporary young college students to pass on the Chinese spirit in their innovative and entrepreneurial behaviors spontaneously.

2.1.2. Favorable for innovation and entrepreneurship landing and cultivating cultural identity. The education system of innovation and entrepreneurship originates from the West, and in the process of education and teaching, there are a large number of Western cases and Western culture. Under this kind of subconscious cultivation, entrepreneurs subconsciously focus on the Western elements when carrying out innovation and entrepreneurship behaviors, and forgetfully ignore the traditional culture, and lack of inheritance of the excellent traditional culture of China. Therefore, attaching importance to cultural self-confidence education in innovation and entrepreneurship education can strongly promote the landing of innovation and entrepreneurship behaviors, make these innovation and entrepreneurship behaviors more in line with China's national conditions, and at the same time more in tune with the "local flavor", effectively expanding the audience of innovation and entrepreneurship, and at the same time, further cultivating contemporary college students' recognition of China's excellent traditional culture. The program will effectively expand the audience of innovation and entrepreneurship, and at the same time further cultivate contemporary college students' recognition of the excellent traditional Chinese culture.

2.1.3. Favorable for establishing global vision and building Chinese brands. From a global perspective, "Chinese brand" building is still insufficient, and lacks the right to speak in the world. Whether in clothing or other industries, China's brand building has been in a backward stage. Emphasizing cultural self-confidence in innovation and entrepreneurship education is the key to building Chinese brands, and building Chinese brands should be an important pursuit of innovation and entrepreneurship education in colleges and universities.

2.2. The role of innovation and entrepreneurship in higher education on cultural self-confidence

2.2.1. Relationship between innovation and entrepreneurship education and firm cultural confidence. Culture needs a carrier to be inherited, and education is one of the best carriers for cultural inheritance. Innovation and entrepreneurship education can be more closely connected with the society because of its special attributes, and it can convey cultural concepts through cultivating innovative and entrepreneurial talents, so as to strengthen cultural confidence. At the same time, looking at the overall education outside the scope of innovation and entrepreneurship education, we can find that education and culture are closely related. Education promotes the prosperity of culture, and education also cultivates talents through cultural knowledge, so the two are interdependent. Innovation and entrepreneurship education also belongs to the scope of education, and cultural

confidence is a positive attitude towards culture, so innovation and entrepreneurship education and cultural confidence are essentially mutually reinforcing.

2.2.2. Cultural education is fundamental to innovation and entrepreneurship education. Innovation and entrepreneurship education in colleges and universities is not only to promote students' employment, nor to cultivate so-called "refined egoists", but to cultivate "well-rounded people". Therefore, we must realize that cultural education is the foundation of innovation and entrepreneurship education in innovation and entrepreneurship education. In teaching, we should combine the "ideological and political course" with the "ideological and political curriculum", and use the platform of innovation and entrepreneurship education to further carry out cultural education, and only in this way can we better cultivate "all-round development of people".

2.2.3. Innovation and entrepreneurship education can strengthen cultural confidence. Innovation and entrepreneurship do not come out of thin air, but rely more on innovation and entrepreneurship from various channels to get inspired, so as to start innovation and entrepreneurship behavior, never behind closed doors. As for innovation and entrepreneurship education, it should absorb and assimilate the excellent foreign cultures for its own use through this carrier, fully demonstrating the characteristics of Chinese culture, and enhancing the degree of cultural self-confidence on the basis of its own culture being more solid. At the same time, through the innovation and entrepreneurship education to cultivate innovative and entrepreneurial talents to further carry out scientific and technological research and development and promotion, when China has a higher level of science and technology, cultural confidence will certainly be accompanied by the development of science and technology and more determined.

3. Identification Model of Cultural Confidence in Innovation and Entrepreneurship Education

This paper combines the fuzzy logic algorithm with the decision tree to construct a recognition model. Through feature extraction and fuzzy reasoning, it is used to identify the degree of cultural confidence in innovation and entrepreneurship education in colleges and universities, which in turn provides reference for the implementation of more culturally confident innovation and entrepreneurship education in colleges and universities.

3.1. Decision trees

A decision tree is a way of dividing the search space of a problem into subsets to be processed separately, which allows the problem to be processed to be learned separately from a whole set of relatively independent events. Decision trees are used to represent classification rules by representing knowledge in the form of a tree [21]. Application of this method requires the construction of a tree for modeling the classification process.

3.1.1. Information Entropy Theory. The implementation of decision trees is based on the theory of information theory. Information theory is a series of reasoning to solve the uncertainty of information transmission, measuring and studying information in a mathematical way. The amount of information is measured by the elimination of uncertainty about the appearance of various symbols in the source after communication. Contains the following concepts:

1) Self-information. Let $X_1, X_2, \dots, X_n$ be the signal sent by the source, before receiving X_i , the recipient's uncertainty about the signal sent by the source is defined as the amount of self-information $I(X_i)$ of the information symbols, i.e.:

$$I(X_i) = \log_2 P(X_i) \quad (1)$$

Where $P(X_i)$ - is the probability that the source sends X_i .

2) Information entropy. Self-information can only reflect the uncertainty of the symbol, while the information entropy can be used to measure the uncertainty of the whole source X as a whole, defined as follows:

$$H(X) = -\sum_{i=1}^n P(X_i) \log_2 P(X_i) \quad (2)$$

Where i - the number of all possible symbols for source X , i.e., the information entropy (average information) is defined in terms of the average amount of self-information provided by the source per symbol sent.

3) Conditional entropy. If source X and random variable Y are not independent of each other, and the recipient receives message Y , then the conditional entropy (XY) concentration measures the uncertainty that exists in the recipient about random variable X at any time after receiving random variable Y . Let X corresponds to the source symbol X_i , Y corresponds to the source symbol Y_i , and $P(X_i/Y_i)$ is the probability that Y is Y_i when X is X_i . Then there are:

$$H(X/Y) = -\sum_{i=1}^n \sum_{j=1}^n P(X, Y_j) \log_2 P(X, Y_j) \quad (3)$$

4) Average mutual information quantity. It is used to express the magnitude of information about X that signal Y can provide, and is expressed in the following equation:

$$I(X, Y) = H(X) - H(X/Y) \quad (4)$$

3.1.2. C4.5 algorithm. For the sample set S , assuming that A is a discrete attribute with v different values, the most computational formula for the segmentation information obtained by segmenting the sample set with A is as follows:

$$E(S_1, S_2, \dots, S_n) = -\sum_{i=1}^s P_i \log_2(P_i) = -\sum_{i=1}^s \frac{|S_i|}{|S|} \times \log_2 \left\{ P \frac{|S_i|}{|S|} \right\} \quad (5)$$

Eq:

S_i - Attribute A divides the training sample set S into v subsample sets with attribute values of a_i .

S - Training sample set.

$E(S_1, S_2, \dots, S_n)$ - The amount of information needed to categorize the samples S .

Out of the fact that some samples take vacant values on some attributes, you can use C4.5 to set a weight for each sample. Starting all samples with a weight of 1.0. when the test attribute A is selected from sample set S dividing S into v sub-sample sets $T_1, T_2, \dots, T_v$, for each sub-sample set T_i it contains samples with vacant values $A=a_i$ and A in S . The weights of the samples containing vacant values in S_i are proportional to the ratio of the number of samples with A values vacant to the number of samples with A values not vacant in S_i .

Data preprocessing is performed before constructing the decision tree. Assume that A is selected as the attribute for this classification according to the information theoretic definition. Let set s_i be a collection of s_{ij} data samples, and its entropy is calculated as follows:

$$E(A) = -\sum_{j=1}^n \frac{s_{1j} + s_{2j} + \dots + s_{nj}}{s} \sum_{i=1}^n p_{ij} \log_2(p_{ij}) \quad (6)$$

Eq:

$p_i - p_i = \frac{s_{ij}}{S_j}$ is the probability that the sample in S_j belongs to class C_i .

s - denotes the number of training samples in S .

s_i - The number of samples in the set containing a_i value samples in S .

s_{ij} - denotes the number of samples of class C_i in subset S_j : $E(A)$ - the amount of information needed to categorize the samples S . The above formula gives the calculation of entropy for a subset only. If S is divided into sets $S_1, S_2, \dots, S_n$ according to the value of the category attribute C , there are n classes. The weighted sum of entropy needs to be calculated for these subsets and the formula is shown below:

$$E(S_{1j}, S_{2j}, \dots, S_{nj}) = - \sum_{i=1}^n p_{ij} \log_2(p_{ij}) \quad (7)$$

Eq:

p_y - the probability that $p_y = s_y / S_j$ is one of S_j belonging to category C_i .

n - the number of classes if S is divided into sets $S_1, S_2, \dots, S_n$ according to the value of class attribute X .

$E(S_{1j}, S_{2j}, \dots, S_{nj})$ - the amount of information needed to divide a given subset S_j .

In order to compare the magnitude of entropy of different sets more obviously, the difference (gain) between the entropy of the set before partitioning and the entropy after partitioning is calculated, and the one with a large gain is the node to be selected. The formula is as follows:

$$Gain(C, A) = E(S_1, S_2, \dots, S_n) - E(A) \quad (8)$$

Information gain tends to produce relatively large function values in tests that may produce multiple branches, resulting in a decision tree with many branches and a final prediction that may not be ideal. The information gain rate can compensate for this defect, the information gain rate takes into account the number of sub-nodes produced by each division and the size of each sub-node, one by one, for the objects to be considered, and no longer considers the amount of information embedded in the categorization, the information gain rate of the attribute is defined as:

$$GainRatio(C, A) = \frac{Gain(C, A)}{E(S_1, S_2, \dots, S_n)} \quad (9)$$

3.2. Fuzzy Logic

In fuzzy logic, a proposition is represented by a real number in the closed interval $[0, 1]$. Fuzzy logic uses the concept of affiliation function to distinguish fuzzy sets, deal with fuzzy relationships, and simulate the human brain to implement rule-based reasoning for solving problems due to various uncertainties [22]. Its advantage is that it can effectively express qualitative knowledge and experience with unclear boundaries and effectively solve various uncertainty problems.

3.2.1. Pattern acquisition. Within a certain range, an object (object, event) is appropriately selected as a "sample" or "original sample space". These samples are observed separately, and the synthesis of the observed data constitutes a "model", and all the observed sample data constitute a "model space". In the pattern space, each sample is a point in it, and its position is determined by the data of the pattern in each dimension.

3.2.2. Pattern recognition methods:

1) Classical method. Statistical method:

The main use of statistical decision and estimation "theory", the core is Bayes' law, that is, the minimum probability classification model. The method still has not established a unified theory for the selection of features.

Structural Approach:

The core is the structural description and analysis of patterns. It builds on the early findings of formal languages and the study of computer languages. This method, by searching for the intrinsic structural features of things, decomposes the complex pattern step by step into a number of simple, easy-to-recognize sub-patterns set, and imitates the hierarchical structure of syntax in linguistics, and uses formal language and automata technology to recognize it.

2) Modern Recognition Methods. Such as recognition methods based on fuzzy theory, artificial neural network method and so on.

3.2.3. Selection of Trapezoidal Affiliation Functions. The trapezoidal affiliation function is a nonnegative continuous function defined by the following expression:

$$f = (x, a, b, c, d) = \begin{cases} 0 & x < a \\ \frac{x-a}{b-a} & a \leq x \leq b \\ 1 & 1 \\ \frac{d-x}{d-c} & c \leq x \leq d \\ 0 & d < x \end{cases} \quad (10)$$

Where: x - specify the range of independent variables of the function. a, b, c, d - specify the shape parameters of the trapezoidal affiliation function.

Among the various affiliation functions, some of them only represent the informational ambiguity in the quantitative transformation in the decision-making process, cannot represent the randomness of subjective judgment of the decision-maker, and have the disadvantages that the specific form of the function is difficult to be determined, a single way of determining it, and the transformation of the fuzzy concepts is not accurate enough after determining it, and so on. Drawing on the basic ideas of classical fuzzy theory, trapezoidal affiliation function to fit the value of the input air can effectively overcome the above shortcomings, so this thesis constructs trapezoidal affiliation function.

3.3. Decision tree based fuzzy logic recognition model

The fuzzy logic used in this paper is a rule-based system, where the C4.5 algorithm is used to construct a decision tree, and its outputs apply fuzzy logic if-then rule statements to represent the rules for recognizing cultural confidence.

Such representations have two characteristics: they are qualitative rather than quantitative and they are local knowledge, which relates local "conditions" to local "results". The former can be represented by fuzzy subsets, while the latter requires fuzzy implication or fuzzy relations. This successfully combines the functions of fuzzy set theory and human reasoning. As a rule, a programming language can be modeled by means of a generative function, which in turn can simulate the intelligence of an expert. The affiliation function gives explicitly determined values given by the program. The fuzzy logic classification method used in this paper gives access to many rules. Here the rules based on the input values can determine the output values. This makes it easy to define the classification rules in the form of state-results, where state and result represent the input and output values respectively.

4. Model reasoning and practical applications

Model identification is divided into four parts: data collection, feature extraction, feature selection, and identification of cultural confidence level. The data of innovation and entrepreneurship education courses were obtained from 100 colleges and universities in a province for analysis.

4.1. Decision Tree Module

4.1.1. Feature ordering. Extracting the salient features of innovative entrepreneurship education data information is an important part of making identification. In this paper, the following features are extracted from the indicators of the evaluation scale for innovation and entrepreneurship education in colleges and universities stipulated by the education authorities: the degree of integration of excellent traditional culture (A), the degree of value leadership and ethical cultivation (B), the innovative power of culturally based knowledge (C), the effect of cultivating a sense of social responsibility (D), the degree of openness and tolerance of international culture (E), the effect of excellent cultural program design (F), the degree of excellent culture and practice Degree of combination (G) and strength of multicultural synergy (H).

In the decision tree model, the more a characteristic variable contributes to the overall Gini coefficient decrease of the model, the greater its characteristic importance is, and thus a characteristic importance map can be derived. After calculation, the ranking of feature importance in this paper is shown in Figure 1. It can be seen that the importance of the identified features are A, C, E, D, H, B, G, F from high to low.

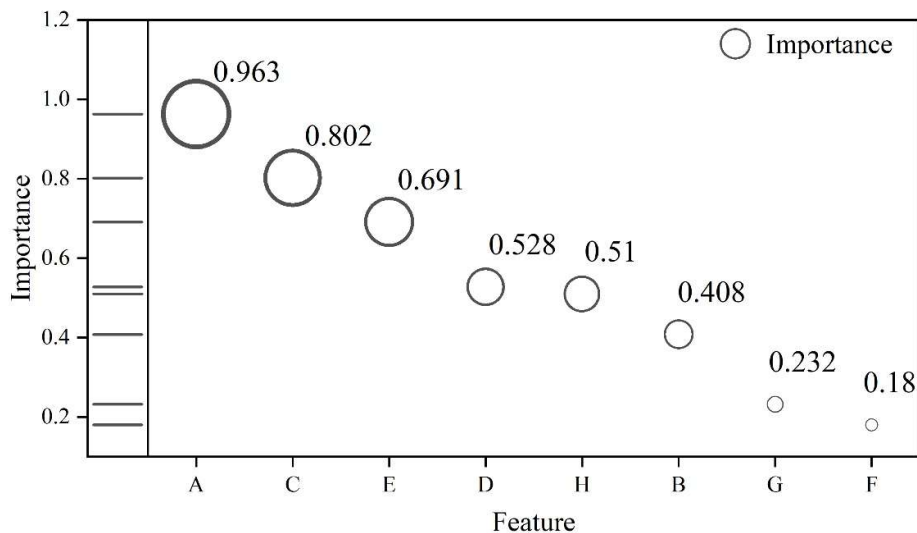


Fig. 1. Ranking of characteristic importance

The optimal decision tree model constructed is shown in Figure 2. It can be seen that the degree of integration of excellent traditional culture (A), the innovative power of knowledge based on culture (C), and the degree of openness and tolerance of international culture (E) play the greatest role in identifying the cultural self-confidence of innovation and entrepreneurship education, which is most suitable for classification, and the degree of integration of excellent traditional culture is the best feature for classification selection of the decision tree.

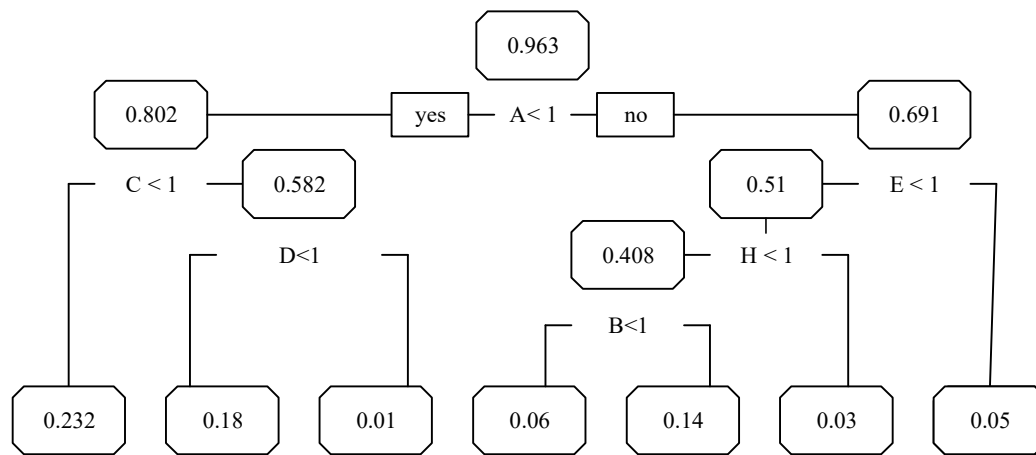


Fig. 2. Optimal decision tree model

4.1.2. **Decision Tree Accuracy Test.** 100 samples each of innovative entrepreneurship education courses with rich cultural confidence, average cultural confidence, and lack of cultural confidence were selected as test samples to evaluate the accuracy of the decision tree, and the resulting mixing matrix is shown in Figure 3, which shows that the accuracy of the decision tree is 88.33%.

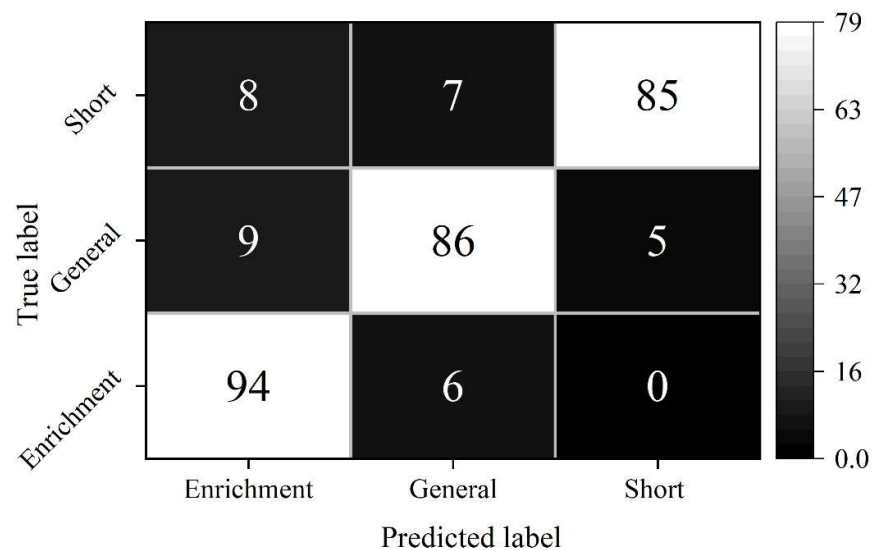


Fig. 3. Mixed matrix

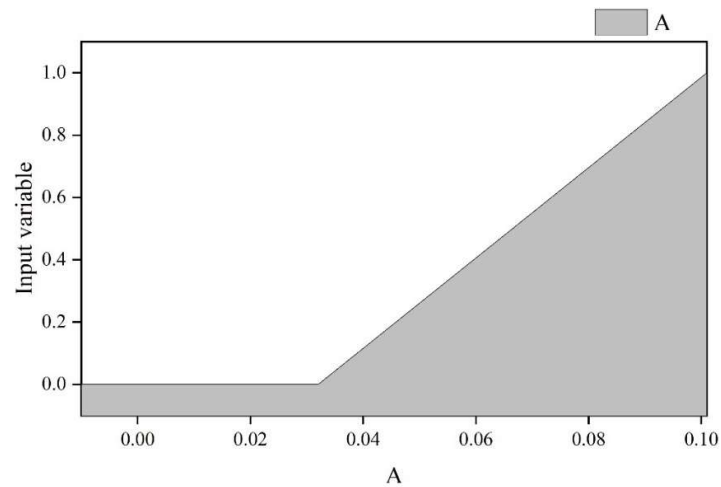
4.2. Fuzzy Logic Reasoning

Fuzzy inference modeling (FIS) is a computational system based on fuzzy set theory, fuzzy rules and fuzzy inference. It successfully combines human reasoning function and fuzzy set theory, which is essentially a computational process of mapping a given input space to a specific output space by means of fuzzy logic, and this mapping process involves some basic theories such as the affiliation function, If-Then rules, and fuzzy logic operations. The commonly used fuzzy inference models are Suge type and Mamdani type, the rule form of Mamdani type fuzzy inference is in line with the habit of people's thinking and language expression, and it can express human knowledge conveniently, so this experiment adopts Mamdani type. First, the input of the system is fuzzy using the modeling of the subordinate function (MF). Then, its output is calculated according to the fuzzy rules. Finally, the output of the system is defuzzified.

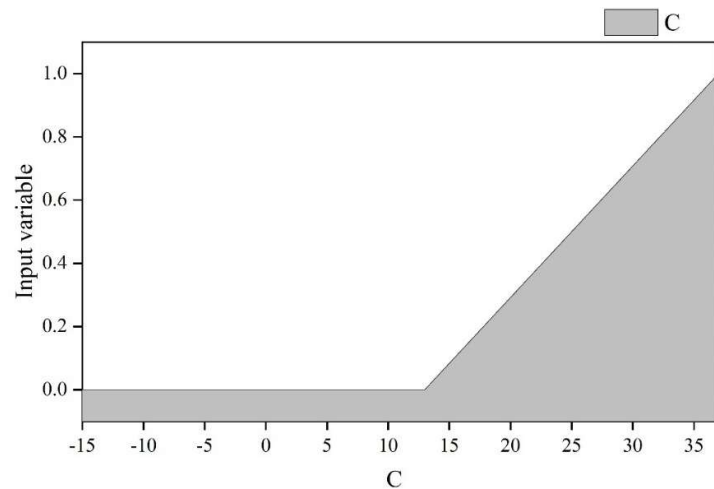
4.2.1. Fuzzy reasoning. From the decision tree generated by the C4.5 algorithm to determine the affiliation function of the fuzzy inference model and the If-Then rule, it is seen that when the degree of international cultural openness and inclusiveness (E) > 500 , the innovation and entrepreneurship course belongs to the general category of cultural self-confidence. When international cultural openness and tolerance (E) ≤ 500 , innovative entrepreneurship courses belong to the rich category of cultural self-confidence, i.e., 500 is the threshold of international cultural openness and tolerance, so the trapezoidal affiliation function is used to fit the values of the input variables. The variable international cultural openness and tolerance (E) contains two thresholds of 500 and 1200, and two affiliation functions $E1$ and $E2$ are defined.

The variable excellent traditional culture integration degree (A) has only one threshold value and only one affiliation function is defined for $A1$, and the variable based on cultural knowledge innovation power (C) has one threshold value and one affiliation function is defined for $C1$.

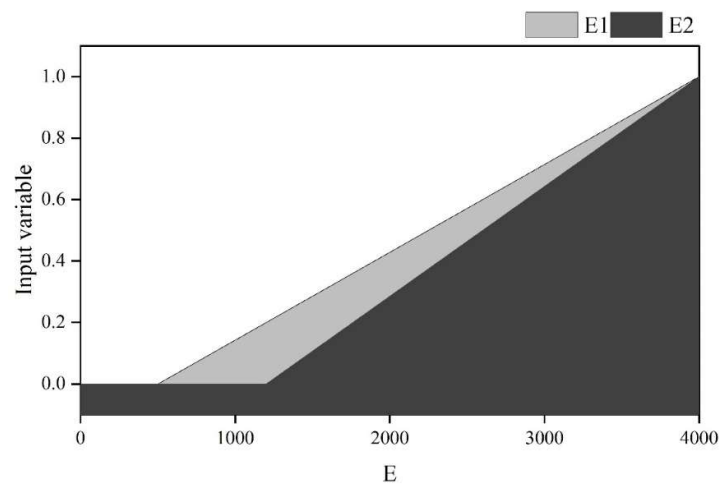
The experimental output includes three possibilities of innovation and entrepreneurship education with rich cultural self-confidence, average cultural self-confidence, and lack of cultural self-confidence, so the affiliation functions of the output variables are defined in the same range. The affiliation functions of input variables and output variables are shown in Fig. 4, and (a)~(d) denote the degree of integration of excellent traditional culture (A), the innovative power of grounded cultural knowledge (C), the degree of international cultural openness and inclusiveness (E), and the affiliation function of the output variable Output, respectively.



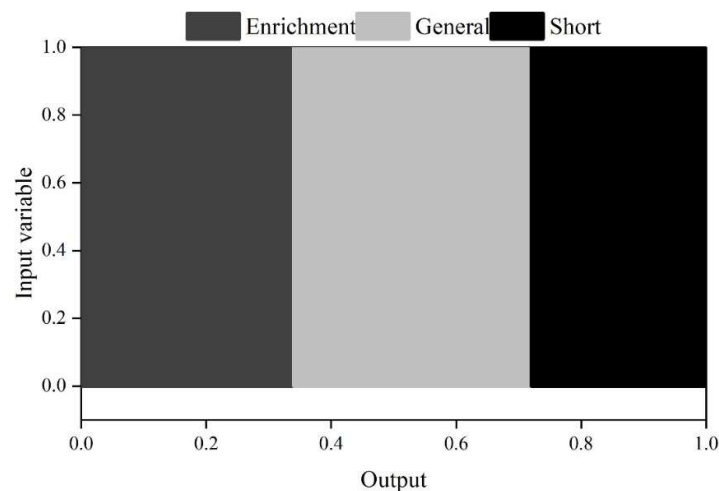
(a) Excellent traditional cultural integration



(b) Based on cultural knowledge innovation



(c) International culture openness and inclusiveness



(d) Output

Fig. 4. Input and output membership functions

Accordingly If-Then rules are used to construct fuzzy rules. All rules are equal, independent of the order of rules.

- 1) If (the degree of integration of excellent traditional culture is not A1) AND (the innovative power of grounded cultural knowledge is not C1) THEN (cultural confidence is average).
- 2) If (the degree of integration of excellent traditional culture is not A1) AND (the innovative power of grounded cultural knowledge is C1) AND (the degree of international cultural openness and tolerance is not E1) THEN (lack of cultural confidence).
- 3) If (the degree of integration of excellent traditional culture is not A1) AND (the innovativeness based on cultural knowledge is C1) AND (the degree of international cultural openness and inclusiveness is E1) THEN (cultural confidence is average).
- 4) If (the degree of integration of excellent traditional culture is A1) AND (the degree of international cultural openness and inclusiveness is not E2) THEN (cultural self-confidence is rich).
- 5) If (the degree of integration of excellent traditional culture is A1) AND (the degree of international cultural openness and inclusiveness is E2) THEN (cultural self-confidence is average).

4.2.2. Practical applications. Apply the model of this paper to identify and classify the cultural confidence level of different innovation and entrepreneurship courses in different departments of five universities, and invite experts to evaluate as a comparison to analyze the model identification

accuracy. For the recognition results are shown in Table 1. It can be seen that the recognition model designed in this paper on the lack of cultural self-confidence in innovation and entrepreneurship education has a better recognition effect, both can reach 100%, and the overall recognition effect on the general cultural self-confidence and cultural self-confidence rich also reached more than 90%. It proves that the model of this paper can test the degree of cultural self-confidence in college students' innovation and entrepreneurship education.

Table 1. Identification result

	Enrichment			General			Short		
	Expert assessment	The model is identified	Accuracy rate	Expert assessment	The model is identified	Accuracy rate	Expert assessment	The model is identified	Accuracy rate
University 1	9	9	100%	14	13	92.86%	3	3	100%
University 2	8	7	87.50%	11	11	100%	6	6	100%
University 3	9	8	88.89%	15	13	86.67%	4	4	100%
University 4	6	6	100%	17	16	94.12%	3	3	100%
University 5	10	9	90.00%	12	12	100%	3	3	100%

5. Strategies of Innovation and Entrepreneurship Education in Colleges and Universities Based on Cultural Confidence

5.1. Strengthening education in traditional culture

The prerequisite for students to develop confidence in culture is firstly to strengthen students' learning of traditional Chinese culture. Although students in colleges and universities have gone through many years of cultural knowledge, there are still certain deficiencies in their understanding of traditional Chinese culture. In order to strengthen the cultural self-confidence of students in innovation and entrepreneurship education, colleges and universities should carry out relevant traditional culture courses and infiltrate traditional culture into students' learning. Innovation and entrepreneurship are often produced only after a certain inspiration, and teachers should expand the cultural scope of students in their inspiration stage, so that students can get the inspiration of innovation and entrepreneurship in the study of traditional culture. For example, nowadays, the innovative entrepreneurship projects of students in many colleges and universities are about the culture of the Forbidden City, the Silk Road and so on. There are also students who integrate traditional culture into new technology, so that traditional culture radiates vigor again. All these reflect China's traditional culture, and from these innovation and entrepreneurship projects, people abroad are also more able to feel China's cultural self-confidence. Traditional culture involves a very wide range, just rely on the teacher's teaching is far from enough, students in colleges and universities should develop good learning habits, take the initiative to learn traditional cultural knowledge.

5.2. Establishment of a rational innovation and entrepreneurship system

Although colleges and universities pay more attention to students' innovation and entrepreneurship, in the actual teaching, the innovation and entrepreneurship program in colleges and universities lacks a certain system. The innovation and entrepreneurship program of colleges and universities is too

empty and lacks certain cultural support. On the basis of cultural self-confidence, colleges and universities should establish a certain system for innovation and entrepreneurship in combination with Chinese culture. Under a reasonable system, innovation and entrepreneurship in colleges and universities can be closer to Chinese culture and can create excellent programs under the foundation of cultural confidence. The system of innovation and entrepreneurship should not only combine the development needs of students, but also combine the traditional Chinese culture to improve the cultural confidence of students. Only when students themselves have confidence in their culture can they find innovative ideas in it. For example, in innovation and entrepreneurship education, teachers should carry out the classification of different innovation projects, so that students can fully expand their own thinking, so that each innovation and entrepreneurship project can be connected with traditional Chinese culture.

5.3. Strengthening the integration of innovation and entrepreneurship resources

Colleges and universities should not only evaluate students' innovation and entrepreneurship, but also provide certain financial and material support for students' innovation and entrepreneurship programs. When integrating the resources for innovation and entrepreneurship, universities should also appropriately integrate Chinese culture. The rich resources contained in traditional culture can become the backup resources for students' innovation and entrepreneurship, for example, Confucianism and culture can be flexibly utilized in the management of entrepreneurial enterprises. Teachers should integrate and reasonably allocate these resources in order to make students realize the role of traditional culture. With the development of network technology, students will inevitably come into contact with a variety of foreign cultures and the impact of information, higher education must strengthen the traditional cultural resources of publicity and learning, so that students can realize the importance of traditional culture for innovative entrepreneurial projects.

6. Conclusion

In this paper, the C4.5 algorithm in decision tree is used to classify the selected features of innovation and entrepreneurship education of college students, and a fuzzy inference model is designed for cultural confidence level recognition based on the selected features of the decision tree and the resulting fuzzy rules. The accuracy of the constructed decision tree for the detection of innovative and entrepreneurial education features reaches 88.33%. The designed fuzzy inference model was used to empirically analyze the degree of cultural confidence. The accuracy of the method in recognizing the lack of cultural self-confidence in innovation and entrepreneurship education reaches 100%, and the overall recognition effect of general cultural self-confidence and rich cultural self-confidence is above 90%. It shows that the method of this paper has high accuracy in detecting and categorizing the effect of innovation and entrepreneurship education for college students, and colleges and universities can evaluate innovation and entrepreneurship education according to the model identification results, reflect on the innovation and entrepreneurship education methods and approaches, and carry out teaching reforms according to the proposed relevant strategies.

Funding

This work was supported by Research Project on the Construction and Reform of Corruption Education System at Wenzhou Polytechnic for the 2023-2024 Academic Year: Research on the Integration Mechanism of Clean Governance Elements and Innovation and Entrepreneurship Education under the Practice of 'Wenzhou Spirit' (WZYQLYB202401).

References

- [1] Yazhao, D. O. N. G. (2020). Research on the Education of Cultural Confidence of College Students in the New Era—Based on the Survey and Analysis of 6 Universities in Zhejiang Province. *The Theory and Practice of Innovation and Entrepreneurship*, 3(24), 112.
- [2] Valencia-Arias, A., Arango-Botero, D., & Sánchez-Torres, J. A. (2022). Promoting entrepreneurship based on university students' perceptions of entrepreneurial attitude, university environment, entrepreneurial culture and entrepreneurial training. *Higher Education, Skills and Work-Based Learning*, 12(2), 328-345.
- [3] Zhang, L. (2020). The Enlightenment of the Concept of Cultural Confidence on International Chinese Education and Cultural Propagation. *Journal of Contemporary Educational Research*, 4(12).
- [4] Li, X., Su, X., Pu, X., Xi, Y., Zhou, L., Xi, W., & Ma, Y. (2023). Research on the Cultivation Path of Cultural Self-confidence under the Perspective of the Strategy of Revitalizing the Country through Science and Education—Using the Chinese Language and Literature Major at Taizhou University as an Example. *Adult and Higher Education*, 5(20), 1-7.
- [5] Ding, Y., & Liu, X. (2018). Analysis on the effectiveness of education in institutions of higher learning based on cultural confidence. In *Data Science and Knowledge Engineering for Sensing Decision Support: Proceedings of the 13th International FLINS Conference (FLINS 2018)* (pp. 1208-1215).
- [6] Xiu, A. (2022). Research On College Students' Cultural Confidence Education In The New Era. *Advances in Education, Humanities and Social Science Research*, 1(2), 188-188.
- [7] Zhang, M. (2022). Research on the Reconstruction of the Cultural Confidence of Higher Vocational College Students from the Perspective of the New Development Concept. *Scientific and Social Research*, 4(1), 163-168.
- [8] Samašonok, K., Išoraitė, M., & Leškienė-Hussey, B. (2016). The internet entrepreneurship: opportunities and problems. *Entrepreneurship and Sustainability Issues*, 3(4), 329.
- [9] Sun, X. (2020). Exploration and practice of "Internet+ Maker education" university Innovative entrepreneurship education model from the perspective of positive psychology. *Frontiers in psychology*, 11, 891.
- [10] Zhou, Q. (2021). Research on the problems and countermeasures of the cultivation of adult college students' innovation and entrepreneurship ability in the internet era. *Open Access Library Journal*, 8(7), 1-12.
- [11] Zhao, D., Zhong, H., Wu, Y., & Zhou, Q. (2020). A study of the impact of internet-based instruction integrated innovation education on university student entrepreneurial team collaboration and strategic innovation. *Frontiers in Psychology*, 11, 1264.
- [12] Akhmetshin, E. M., Mueller, J. E., Chikunov, S. O., Fedchenko, E. A., & Pronskaya, O. N. (2019). Innovative technologies in entrepreneurship education: The case of European and Asian countries. *Journal of Entrepreneurship Education*, 22(1), 1-15.
- [13] Solesvik, M., Westhead, P., & Matlay, H. (2014). Cultural factors and entrepreneurial intention: The role of entrepreneurship education. *Education+ training*, 56(8/9), 680-696.
- [14] Zhou, J., Qi, J., & Shi, X. (2022). The Innovation of Entrepreneurship Education for Intangible Cultural Heritage Inheritance From the Perspective of Entrepreneurial Psychology. *Frontiers in Psychology*, 13, 721219.
- [15] Guo, K. (2020). Research on the Problems and Countermeasures in Cultivation of College Students' Cultural Confidence in the New Era. *Journal of Contemporary Educational Research*, 4(9).

- [16] Junchi, T. L. (2022). From Cultural Resistance to Cultural Commitment: A New Path for Cultivating Cultural Confidence Based on the Law of College Students' Cultural Cognition. *Frontiers in Educational Research*, 5(9).
- [17] Fu, T., & Yu, S. (2023). Research on Cultivating Cultural Confidence of College Students from the Perspective of Digital Transformation. *Adult and Higher Education*, 5(18), 118-123.
- [18] Wei, Z. (2021). Internal Relationship between Education on Cultural Confidence and Cultural Consciousness. *Journal of Contemporary Educational Research*, 5(10), 121-125.
- [19] Han, C. (2020, February). New Media: Cultural Confidence and Core Values Education in Colleges and Universities. In *6th International Conference on Education, Language, Art and Inter-cultural Communication (ICELAIC 2019)* (pp. 157-160). Atlantis Press.
- [20] Zhou Zhengxu. (2024). Analysis of Innovative Strategies of Classical Chinese Education in Colleges and Universities from the Perspective of Cultural Confidence. *Education Reform and Development*(9),153-159.
- [21] Benjamín Luna Benoso, José Cruz Martínez Perales, Úrsula Samantha Morales Rodríguez, Rolando Flores Carapia & Víctor Manuel Silva García. (2024). A New Classification Model Using a Decision Tree Generated from Hyperplanes in Dimensional Space. *Applied Artificial Intelligence*(1).
- [22] Ayush Sahu ,Satish Sinha& Haider Banka. (2024). Fuzzy inference system using genetic algorithm and pattern search for predicting roof fall rate in underground coal mines. *International Journal of Coal Science & Technology*(1),1-1.