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Construction of Fuzzy Information Assessment Method Based on Fuzzy Logistic Regression Algorithm in the Performance Evaluation of School-Enterprise Integration of Higher Vocational Hospitality Management Major

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ABSTRACT

School-enterprise integration is an effective way to improve the running level of higher vocational colleges and universities and stimulate the innovation vitality of enterprises. This paper takes the higher vocational hotel management profession as the research object, combines IPO model and intuitionistic fuzzy hierarchical analysis method (IFAHP) to realize the construction of school-enterprise integration performance evaluation index system, and utilizes the fuzzy comprehensive evaluation method (FCE) to carry out specific application of this evaluation system. On this basis, the fuzzy set qualitative comparative analysis (fsQCA) was used to explore the specific path of school-enterprise collaborative education in higher vocational colleges. The empirical study shows that the constructed evaluation system of school-enterprise integration has high reliability and operability, which is conducive to horizontal and vertical comparisons of higher vocational colleges and universities, and is also applicable to the authorities of higher vocational colleges and universities and the third-party evaluation organizations for the performance evaluation of school-enterprise integration. At the same time, it also indicates that the realization of high-performance school-enterprise collaborative parenting programs in higher vocational hotel management majors cannot be achieved through a single variable, but rather through the form of conditional grouping to play a key role. There are five paths to improve the effectiveness of university-enterprise collaborative parenting in colleges and universities, and in the paths, the enterprise scale, the pre-project input and the project implementation process are the core conditions to improve the effectiveness of university-enterprise collaborative parenting in higher vocational colleges and universities, and the combination of changes of the three plays a decisive role in different condition grouping states.

Keywords: IPO model, intuitionistic fuzzy hierarchical analysis, fuzzy comprehensive evaluation, fsQCA method, school-enterprise integration

1. Introduction

With the rapid development of social economy and the continuous adjustment of industrial structure,

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the demand for high-quality skilled personnel is becoming more and more urgent, and school-enterprise cooperation has become one of the important ways of talent cultivation in colleges and universities. The specific types of school-enterprise cooperation and collaborative education in the context of school-enterprise integration, in the construction process should not only focus on the implementation of the national policy of industry-teaching integration, but also be based on the connotation of the construction of higher vocational colleges and universities and the operational mechanism [1-3]. The development of school-enterprise integration can only ensure that the professional construction of higher vocational colleges and universities is in the right direction, the path is scientific, and meets the needs of social development, which can realize the sharing of educational resources, improve the innovation and practice ability of students, and better satisfy the employment needs of society [4-7]. The performance evaluation of school-enterprise integration is of great significance in promoting the in-depth development of cooperation between the two sides and improving the quality of teaching and research [8]. In addition, Tan and Zhang [9] pointed out that the performance evaluation of school-enterprise cooperation in order to identify cooperation problems and explore the depth of cooperation in order to improve the effectiveness of cooperation, as well as to promote teaching reform. Therefore, it is imperative to develop and implement a performance evaluation program for school-enterprise integration.

According to statistics, there are nearly 90% of higher vocational colleges and universities are promoting school-enterprise cooperation, and the employment rate of students receiving school-enterprise cooperation in a few colleges and universities is as high as 98%, while the satisfaction rate of school-enterprise cooperation in practice is less than 50%, and the overall presentation of the high promotion of cooperation and the low implementation of efficiency [10-12]. It can be seen that the practice of school-enterprise integration is poor, and there is a situation of backward performance evaluation. In most colleges and universities, school-enterprise integration is only reflected by the surface data of students' internship rate, enterprises' job contribution rate, and students' internship hours, and there is a lack of evaluation on the utilization of related resources in school-enterprise integration, whether the cooperation only presents superficial labor dispatch, and whether the internship jobs are related to majors [13-16]. At the same time, due to many factors such as students' concern about internship results, exaggerated school data, low sense of responsibility of enterprises, etc., the evaluation of internship or practice in enterprises in the middle and late stages of internship and at the end of internship, as well as the feedback from enterprises to students on internship practice are mostly characterized by subjective interference and fuzzy information, which leads to inaccurate results of the final evaluation, and affects the depth and sustainability of the integration between schools and enterprises [17-20].

As a profession closely linked with the market, the hotel management profession is predicted by relevant organizations that China will become one of the fastest growing countries in the world in the hotel industry [21]. Therefore, in such a background, in order to better meet the development of China's hotel industry, higher vocational colleges and universities have implemented school-enterprise integration training programs. The hotel management program, however, faces complex, ambiguous, and multidimensional challenges in evaluating its performance due to market fluctuations, changes in the employment environment, the impact of the new crown epidemic, the stakeholders of school-enterprise cooperation, and the lagging nature of the results of school-enterprise cooperation [22-23].

As far as the current research on the performance evaluation of school-enterprise integration is concerned, the research for the hospitality management program is still in its infancy, and most of it is aimed at the comprehensive performance evaluation of school-enterprise cooperation. Zhou et al [24] synthesized the hierarchical analysis method, entropy value method, and linear weighting method to weight the evaluation indicators of school-enterprise cooperation laboratories to determine the individual weights and comprehensive weights of the indicators, so as to realize the overall evaluation of the effect. Han and Xu [25] in based on TODIM (Technique for Order Preference by Similarity to Ideal Solution), VIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenje), and Binary Linguistic Pythagorean Fuzzy Sets tools were constructed to evaluate the performance of school-enterprise cooperation. Yan [26] processed the segmented data of evaluation indexes through fuzzy C4.5 algorithm under the support of decision tree technology, classified the processed data, and designed the decision tree at the same time, so as to optimize the evaluation of school-enterprise cooperation performance. Yu et al [27] used the optimized hierarchical analysis method to calculate the weights of 25 evaluation indicators of school-enterprise cooperation and innovation performance, and used the fuzzy comprehensive evaluation method to construct the evaluation model, which is effective.

With the development of the field of artificial intelligence, fuzzy information evaluation is getting more and more attention, fuzzy logic is a mathematical method that extends the traditional logic to deal with fuzzy, uncertain and ambiguous data in real life [28]. Whereas the goal of logistic regression algorithm is to construct a mathematical model to predict the classification results of new unknown data by learning from known training data and it is used to solve binary classification problems [29]. The fuzzy logistic regression algorithm is an extended algorithm as a fusion of the advantages of the two, which is capable of performing fuzzy problem exploration as well as solving classification problems [30]. This provides a new paradigm for the complex performance evaluation in school-enterprise cooperation in hospitality management in higher vocational colleges and universities.

In this paper, IPO model, intuitionistic fuzzy hierarchical analysis and fuzzy comprehensive evaluation are comprehensively used to realize the construction and application of school-enterprise integration performance evaluation system for higher vocational hotel management majors. Firstly, based on the IPO model (Input-Process-Output model), we constructed the thinking framework of school-enterprise integration performance evaluation in higher vocational colleges and universities, and determined the school-enterprise integration performance evaluation system and the weight coefficients of related indexes by using the Delphi method and the IFAHP method. In order to assess the effectiveness of the constructed evaluation system, the fuzzy comprehensive evaluation method is applied to the horizontal and vertical comparisons of higher vocational colleges and universities, and compared with the actual performance. In addition, this paper applies the fsQCA method to analyze the relevant paths of school-enterprise collaborative education in higher vocational colleges.

2. Construction and Application of Performance Evaluation System for School-Enterprise Integration in Higher Vocational Institutions

2.1. *Performance Evaluation Framework for School-Enterprise Integration Based on IPO Modeling*

This study introduces the IPO model into school-enterprise integration performance evaluation, and constructs a school-enterprise integration performance evaluation model for hotel management majors in higher vocational colleges and universities.The IPO evaluation model contains three dimensions: input evaluation, process evaluation and output evaluation, with input evaluation and process evaluation belonging to the process evaluation indexes, and output evaluation being the outcome evaluation indexes, so the evaluation index system of the IPO model can take into account the process and outcome evaluation indexes and meet the requirements of the whole process evaluation of school-enterprise integration performance. Therefore, the evaluation index system of IPO model can take into account both process and result evaluation indexes and meet the requirements of the whole process evaluation of school-enterprise integration performance. The thinking framework of school-enterprise integration performance evaluation is shown in Figure 1.

The inputs for school-enterprise integration refer to the inputs in construction funds, human resources, practical training venues, etc., and the inputs in each aspect are positively correlated with the performance of school-enterprise integration to a certain extent. The process index of school-enterprise integration is a dynamic index, and a better dynamic index can promote the deepening of school-enterprise integration, which mainly includes professional construction, technological innovation, teaching and training, of which professional construction is the foundation, technological innovation is the driving force, and teaching and training is the guarantee. The performance of school-enterprise integration is to show the performance of each subject in the input and process construction, which is the initial motivation of each subject to participate in school-enterprise integration, and is a degree of recognition of the innovative results shown by each subject.

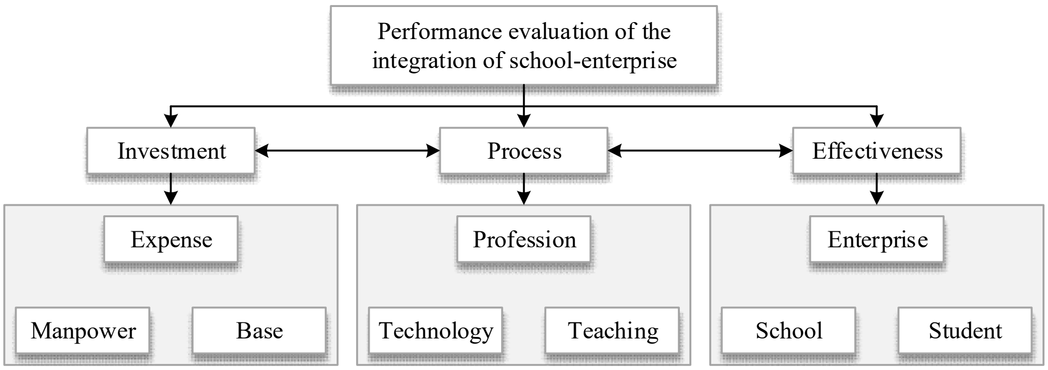

Fig. 1. School-enterprise integration performance evaluation thinking frame

According to the theoretical framework of the school-enterprise integration performance IPO model, the input evaluation, process evaluation and output evaluation in the model are drawn upon to design the specific evaluation scope, evaluation objectives and evaluation contents of the school-enterprise integration performance evaluation of the higher vocational hotel management specialty. The specific contents of the constructed school-enterprise integration performance evaluation model are as follows:

1) School-enterprise integration resource allocation (IPO model input evaluation). Evaluation objective: the input of school-enterprise integration implementation resources.

Evaluation content: school-enterprise collaboration for teaching resources co-construction, including financial input, teacher team, practical training base, etc.

2) School-enterprise integration implementation process (corresponding to IPO model process evaluation). Evaluation Objective: School-enterprise integration construction process, implementation overview.

Evaluation content: the implementation process of school-enterprise collaborative education, including school-enterprise collaborative construction of specialties and design of talent cultivation programs, technological innovation and cooperation, teaching and training, etc.

3) Achievements and benefits of school-enterprise integration (corresponding to IPO model output evaluation). Evaluation Objective: Objectively evaluate the implementation effect of school-enterprise integration.

Evaluation content: the effectiveness of school-enterprise collaborative education, including enterprise benefit, school benefit and student satisfaction, etc.

2.2. Construction of school-enterprise integration performance evaluation system based on IFAHP

In this section, the intuitionistic fuzzy hierarchy analysis method (IFAHP) is applied to the construction of school-enterprise integration performance evaluation system for senior hotel management majors.

2.2.1. Intuitionistic Fuzzy Hierarchy Analysis (IFAHP). Intuitionistic Fuzzy Hierarchy Analysis (IFAHP) [31] is a fuzzy decision-making method based on fuzzy set theory. This method takes into account the hesitancy shown by the experts in the evaluation process and makes the set method of qualitative and quantitative factors agreeable. At the same time, this method is able to automatically correct the non-consistent intuitionistic fuzzy preference relations that appear in the evaluation without returning to the experts for reevaluation, which can effectively improve the accuracy and operability of the evaluation.

The process of using intuitionistic fuzzy hierarchical analysis to calculate the weights of school-enterprise integration performance evaluation indexes for higher vocational hotel management majors is as follows:

1) Construct intuitionistic fuzzy judgment matrix. According to the established evaluation index system of school-enterprise integration of higher vocational hotel management majors, experts are invited to compare the importance of each level of indexes relative to the corresponding indexes of the previous level two by two, so as to establish the intuitionistic fuzzy judgment matrix:

$$R=(r_{ik})_{m\times m} \tag{1}$$

Where $r_{ik}=(\mu_{ik},v_{ik})$, μ_{ik} denotes the degree of affiliation, i.e., the degree to which the i th indicator is superior to the k th indicator. v_{ik} denotes the degree of non-affiliation, i.e., the degree to which the i th indicator is inferior to the k th indicator. π_k denotes the degree of hesitancy, $\pi_{ik}=1-\mu_{ik}-v_{ik}$.

2) Consistency test. The consistency of the intuitionistic fuzzy judgment matrix can be determined by the distance of the intuitionistic fuzzy set, and the test formula is as follows:

$$d(\bar{R},R)=\frac{1}{2(m-1)(m-2)}\sum_{i=1}^{m}\sum_{k=1}^{m}(|\bar{\mu}_{ik}-\mu_{ik}|+|\bar{v}_{ik}-v_{ik}|+|\bar{\pi}_{ik}-\pi_{ik}|) \tag{2}$$

Where $R=(r_{ik})_{m\times m}$ is the intuitionistic fuzzy judgment matrix, and $\bar{R}=(\bar{r}_{ik})_{m\times m}$ is the corresponding perfect-consistency intuitionistic fuzzy judgment matrix of R, which is constructed as follows:

(1) When $k>i+1$, let $\bar{r}_{ik}=(\bar{\mu}_{ik},\bar{v}_{ik})$, where:

$$\bar{\mu}_{ik}=\frac{\sqrt[k-i-1]{\prod_{i=i+1}^{k-1}\mu_{ik}\mu_{ik}}}{\sqrt[k-i-1]{\prod_{i=i+1}^{k-1}\mu_{ik}\mu_{ik}}+\sqrt[k-i-1]{\prod_{i=i+1}^{k-1}(1-\mu_{ik})(1-\mu_{ik})}},k>i+1 \tag{3}$$

$$\bar{V}_{ik}=\frac{\sqrt[k-i-1]{\prod_{t=i+1}^{k-1}v_{ik}v_{ik}}}{\sqrt[k-i-1]{\prod_{t=i+1}^{k-1}v_{ik}v_{ik}}+\sqrt[k-i-1]{\prod_{t=i+1}^{k-1}(1-v_{ik})(1-v_{ik})}},k>i+1 \tag{4}$$

(2) When $k=i+1$, let $\bar{r}_{ik}=r_{ik}$.

(3) When $k<i$, let $\bar{r}_{ik}=(\bar{v}_{ki},\bar{\mu}_{ki})$.

If $d(\bar{R},R)<0.1$, the intuitionistic fuzzy judgment matrix R passes the consistency test. If $d(\bar{R},R)\geq 0.1$, the intuitionistic fuzzy judgment matrix R fails the consistency test, at this time, the intuitionistic fuzzy judgment matrix R can be synthesized with its corresponding perfect consistency intuitionistic fuzzy judgment matrix $\bar{R}$ and a new intuitionistic fuzzy judgment matrix $\tilde{R}=(\tilde{r}_{ik})_{m\times m}$, each element of which is defined as:

$$\tilde{\mu}_{ik}=\frac{(\mu_{ik})^{1-\sigma}(\bar{\mu}_{ik})^{\sigma}}{(\mu_{ik})^{1-\sigma}(\bar{\mu}_{ik})^{\sigma}+(1-\mu_{ik})^{1-\sigma}(1-\bar{\mu}_{ik})^{\sigma}},i,k=1,2,\cdots,m \tag{5}$$

$$\tilde{v}_{ik} = \frac{(v_{ik})^{1-\sigma}(\overline{v}_{ik})^{\sigma}}{(v_{ik})^{1-\sigma}(\overline{v}_{ik})^{\sigma} + (1-v_{ik})^{1-\sigma}(1-\overline{v}_{ik})^{\sigma}}, i,k = 1,2,\cdots,m \tag{6}$$

Where σ is a control parameter, $\sigma \in [0,1]$, the smaller the value of σ, the closer $\tilde{R}$ is to R.

For the new intuitionistic fuzzy judgment matrix $\tilde{R}$, the consistency test is performed using the following formula:

$$d(\overline{R},\tilde{R}) = \frac{1}{2(m-1)(m-2)}\sum_{i=1}^{m}\sum_{k=1}^{m}(|\overline{\mu}_{ik} - \tilde{\mu}_{ik}| + |\overline{v}_{ik} - \tilde{v}_{ik}| + |\overline{\pi}_{ik} - \tilde{\pi}_{ik}|) \tag{7}$$

If $d(\overline{R},\tilde{R}) < 0.1$, the intuitionistic fuzzy judgment matrix $\tilde{R}$ passes the consistency test, otherwise the control parameters σ are adjusted again to get a new intuitionistic fuzzy judgment matrix $\tilde{R}$ until $d(\overline{R},\tilde{R}) < 0.1$.

3) Calculate the intuitionistic fuzzy weights of indicators. For the intuitionistic fuzzy judgment matrix $\tilde{R} = (\tilde{r}_{ik})_{m\times m}$ that passes the consistency test, where $\tilde{r}_{ik} = (\tilde{\mu}_{ik}, \tilde{v}_{ik})$, using the normalized sequential summation method to calculate the weight of each indicator relative to the corresponding indicator at the previous level:

$$\omega_i = \left(\frac{\sum_{k=1}^{m}\tilde{\mu}_{ik}}{\sum_{i=1}^{m}\sum_{k=1}^{m}(1-\tilde{v}_{ik})}, 1 - \frac{\sum_{k=1}^{m}(1-\tilde{v}_{ik})}{\sum_{i=1}^{m}\sum_{k=1}^{m}\tilde{\mu}_{ik}} \right), i = 1,2,\cdots,m \tag{8}$$

4) Intuitionistic fuzzy number weight conversion. According to the similarity function of the intuitionistic fuzzy number, the intuitionistic fuzzy number weights of the evaluation indexes can be transformed into real number weights:

$$L(\omega_i) = \frac{1 - v_{\omega_i}}{1 + \pi_{\omega_i}} \tag{9}$$

where ω_i is the intuitionistic fuzzy number weight of indicator i with respect to the indicator at the previous level, $\omega_i = (\mu_i, v_i)$, $\pi_i = 1 - \mu_i - v_i$, $L(\omega_i)$ is the real weight of indicator i with respect to the indicator at the previous level.

2.2.2. Selection of evaluation indicators:

1) Selection of first-level evaluation indicators. Based on the IPO model, the first-level indicators of school-enterprise integration performance evaluation are divided into three dimensions: "school-enterprise integration investment (A_1)", "school-enterprise integration process (A_2)" and "school-enterprise integration effectiveness (A_3)", which correspond to "input evaluation", "process evaluation" and "output evaluation" in the IPO model, respectively.

2) Selection of secondary evaluation indicators:

(1) Under the school-enterprise integration investment (A_1), three secondary indicators of "capital investment (A_{11})", "teaching staff (A_{12})" and "training room base construction (A_{13})" were established. In terms of funding, it mainly covers government investment (A_{111}), industry enterprise investment (A_{112}), annual payment of part-time teachers' remuneration to enterprises (A_{113}), and annual financial allocation (A_{114}). Under the dimension of teaching staff, it mainly includes the proportion of full-time teachers in "double-teacher" teachers (A_{121}), the proportion of part-time teachers in enterprises (A_{122}), the proportion of full-time teachers in enterprises for temporary training (A_{123}) and the proportion of part-time teachers in enterprises teaching professional courses (A_{124}). The construction of training bases, including the construction of on-campus training bases (A_{131}) and off-campus training bases (A_{132}), is an indispensable infrastructure for school-enterprise integration.

(2) The process of school-enterprise integration (A_2) can be jointly constructed from the aspects of

"professional construction (A_{21})", "technological innovation (A_{22})" and "teaching and training (A_{23})". Under the dimension of major construction, there are four indicators: the matching degree between major setting and regional key industries (A_{211}), the total number of cooperative enterprises (A_{212}), the proportion of school-enterprise integration majors (A_{213}) and the professional relevance of cooperative enterprises (A_{214}). As one of the dimensions of the school-enterprise integration process, technological innovation provides innovative vitality for regional economic development and industrial upgrading, which can include the number of cooperative R&D projects (A_{221}), the total amount of cooperative R&D project funding (A_{222}), the number of cooperative R&D patents (A_{223}), and the benefits obtained from the transformation of cooperative R&D patents or achievements (A_{224}). In the context of school-enterprise integration, the cooperation between schools and enterprises to carry out talent training, including order training, modern apprenticeship pilot, talent training program formulation, teaching standard formulation, etc., can reflect the higher and vocational nature of talent training in higher vocational colleges, including the proportion of "order class" pilot students (A_{231}), the proportion of top internship students (A_{232}), the proportion of modern apprenticeship pilot students (A_{233}), The number of social training carried out by school-enterprise cooperation (A_{234}) and the amount of non-academic training (A_{235}).

(3) The effectiveness of school-enterprise integration (A_3) is reflected in "enterprise benefits (A_{31})", "school benefits (A_{32})" and "student satisfaction (A_{33})". Among the stakeholders of school-enterprise integration, the enterprise benefits mainly include the number of graduates employed in cooperative enterprises (A_{311}), the economic benefits created by school-enterprise integration (A_{312}), the social benefits of enterprises (A_{313}), and the improvement of popularity (A_{314}). The interests of the university mainly include the employment rate of graduates (A_{321}), the employment rate of graduates (A_{322}), the rate of obtaining "double certificates" of graduates (A_{323}), the satisfaction of employers with graduates (A_{324}), and the proportion of graduates employed in top $_{500}$ enterprises (A_{325}), which are also important indicators to reflect the effectiveness of school-enterprise integration. Student satisfaction can include satisfaction with enterprises (A_{331}), satisfaction with teachers (A_{332}), and satisfaction with their own internship results (A_{333}), which can provide reference for higher vocational colleges to revise the goal of school-enterprise integration.

3) Establishment of hierarchical structure model. Based on the above analysis, using intuitionistic fuzzy hierarchical analysis, the performance evaluation indexes of school-enterprise integration of hotel management majors in higher vocational colleges and universities can be divided into three levels, and the hierarchical structure model is shown in Table 1.

Table 1. Hierarchical structure model

Primary index	Secondary index	Three-level index
Input of Integration of school and enterprise (A1)	Funding input (A11)	A111
		A112
		A113
		A114
	Teaching staff (A12)	A121
		A122
		A123
		A124
	Training base construction (A13)	A131
		A132
Process of integration of school and enterprise (A2)	Professional construction (A21)	A211
		A212
		A213

		A214
	Technological innovation (A22)	A221
		A222
		A223
		A224
	Teaching and training (A23)	A231
		A232
		A233
		A234
		A235
Effect of integration of school and enterprise (A3)	Enterprise benefit (A31)	A311
		A312
		A313
	School benefit (A32)	A321
		A322
		A323
		A324
		A325
	Student satisfaction (A33)	A331
		A332
		A333

2.2.3. Determination of indicator weights. Using the Delphi method [32] and intuitionistic fuzzy hierarchical analysis, the weights of the school-enterprise integration performance evaluation indexes of higher vocational hotel management majors can be determined. The weight calculation is divided into two steps: constructing judgment matrix and expert scores, weight calculation and consistency test.

1) Constructing judgment matrix and expert rating. The judgment matrix can be constructed by comparing the indicators at all levels in the school-enterprise integration performance evaluation index system with each other. According to the Delphi method, 10 experts are invited to compare the importance and score the two comparisons of the index variables in the judgment matrix by means of back-to-back communication solicitation. 10 experts come from 5 higher vocational colleges and universities and 3 enterprises, among which there are 3 persons in charge of the Academic Affairs Office of the higher vocational colleges and universities, 2 persons in charge of the hospitality management specialty, 3 persons in charge of the School-Enterprise Cooperation Office, 2 persons in charge of the personnel manager of the enterprise. The principle of expert scoring takes the 1-9 scale method, and the size of the value represents the importance of the former over the latter. That is, when the two are equally important, the rating is 1. When the former is slightly more important than the latter, the rating is 3. When the former is obviously more important than the latter, the rating is 5. When the former is more important than the latter, the rating is 7. When the former is more important than the latter, the rating is 9. The other values are in the same order.

Taking Expert 2 as an example, the scoring of the first-level indicator judgment matrix is shown in Figure 2, where "Input", "Process" and "Effect" represent "school-enterprise integration investment", "school-enterprise integration process" and "school-enterprise integration effect", respectively. The score of "school-enterprise integration investment" versus "school-enterprise integration effectiveness" is 3, which indicates that expert 2 believes that the former is slightly more important than the latter.

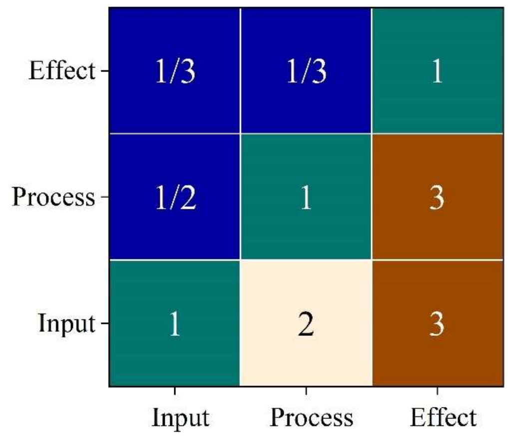

Fig. 2. The judgement matrix of the first level index and the score of the expert 2

2) Weight calculation and consistency test. Commonly used weight calculation methods include the power method, square root method, canonical column averaging method, etc. In this study, the canonical column averaging method is used. Since the expert rating may be one-sided, the consistency test of the judgment matrix is also required in the weight calculation. Only by passing the test can it be shown that the judgment matrix is logically sound and the results can be continued to be analyzed.

Taking Expert 2 as an example, the weights of the judgment matrix of the first-level indicators are calculated and consistency test is performed. First, the judgment matrix is constructed based on the score of expert 2 on the first-level indicators. Then, the maximum eigenvalue $\lambda = 3.0538$ of this judgment matrix, the consistency test value $CR = 0.0517$, and the weight vector $W_2 = (0.53, 0.33, 0.14)$ are calculated. The consistency test value $CR = 0.0517$ is less than 0.1, indicating that the consistency of this judgment matrix is acceptable, and the weight vector W_2 can be recognized as the weight given by expert 2 for the level 1 indicators.

Similarly, according to the judgment matrix given by the other 9 experts for the first-level indicators, the corresponding weight vectors were calculated respectively, and then the arithmetic average was made to get the average weight vector.The weight vectors and arithmetic average of the ratings of the 10 experts are shown in Table 2. It can be seen that the weights of school-enterprise integration input, school-enterprise integration process, and school-enterprise integration effectiveness are 0.36, 0.47, and 0.18, respectively.This indicates that the experts think that the process of school-enterprise integration is the most important, followed by school-enterprise integration input and school-enterprise integration effectiveness.

Table 2. Weight vector and arithmetic average of 10 expert ratings

Weight vector	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Arithmetic mean
Input	0.24	0.53	0.42	0.51	0.52	0.18	0.29	0.41	0.29	0.23	0.36
Process	0.61	0.33	0.40	0.30	0.31	0.55	0.50	0.43	0.48	0.63	0.46
Effect	0.15	0.14	0.18	0.19	0.17	0.27	0.21	0.16	0.23	0.14	0.18

Similarly, the weights of evaluation indicators at all levels can be calculated. As a result, the performance evaluation system of school-enterprise integration of hotel management majors in higher vocational colleges and universities can be obtained as shown in Table 3.

Table 3. Hierarchical structure model

Primary index	Weight	Secondary index	Weight	Three-level index	Weight
A1	0.36	A11	0.61	A111	0.31
				A112	0.28
				A113	0.21
				A114	0.20
		A12	0.24	A121	0.28
				A122	0.29
				A123	0.18
				A124	0.25
		A13	0.15	A131	0.44
				A132	0.56
A2	0.46	A21	0.57	A211	0.33
				A212	0.25
				A213	0.21
				A214	0.21
		A22	0.27	A221	0.31
				A222	0.24
				A223	0.26
				A224	0.19
		A23	0.16	A231	0.18
				A232	0.21
				A233	0.19
				A234	0.18
				A235	0.24
A3	0.18	A31	0.55	A311	0.33
				A312	0.29
				A313	0.38
		A32	0.30	A321	0.21
				A322	0.19
				A323	0.14
				A324	0.24
				A325	0.12
		A33	0.15	A331	0.33
				A332	0.29
				A333	0.38

2.3. Application of school-enterprise integration performance evaluation system based on FCE

In this section, based on the Fuzzy Comprehensive Evaluation (FCE) method, the constructed school-enterprise integration performance evaluation system is practically applied to assess the effectiveness of the evaluation system.

2.3.1. Fuzzy Comprehensive Evaluation Method (FCE). Fuzzy comprehensive evaluation (FCE) [33] is a systematic evaluation method that combines qualitative and quantitative analysis, and a comprehensive evaluation method that draws on fuzzy set theory by combining precise and imprecise values. Its basic principle is: to synthesize the multi-category and multi-level factors that play an influential role in the problem, first determine the indicator set, comment set and points assigned to the evaluation object, calculate the corresponding weight of each indicator based on the degree of importance, and then establish the fuzzy judgment matrix, consider the weight matrix and judgment matrix comprehensively, and then calculate through the formula to obtain the comprehensive evaluation results of the research object.

The performance level of university-enterprise integration in higher vocational colleges and universities is affected by many elements, such as the input and action motivation of the main body of interest, and the university-enterprise integration of the education and teaching process, etc. It is not possible to evaluate the performance of university-enterprise integration by simply using "high level" or "low level", which is a typical problem of cognitive uncertainty. It is a typical cognitive uncertainty problem, and it is necessary to comprehensively consider various elements, that is, to evaluate the input performance, process performance, and effect performance of school-enterprise integration from multiple indicators. Based on the above analysis, the use of fuzzy comprehensive evaluation method can effectively measure the performance of school-enterprise integration of hotel management majors in higher vocational colleges and universities, and analyze the development of which is insufficient to propose targeted strategies. The specific steps are as follows:

1) Determine the evaluation index set. The definition of the first-level indicator set, set the set as $A=\{A_1, A_2, A_3..., A_k\}$, indicating that there are a total of k subsets of evaluation indicators in this indicator set, e.g., Level 1 indicators = {School-Enterprise Integration Input Indicators, School-Enterprise Integration Process Indicators, School-Enterprise Integration Effect Indicators}. The second-level indicator set is recorded as the set $A_1=\{A_{11}, A_{12}, A_{13}\}$ ={Investment in funding, faculty, training base building}, $A_2=\{A_{21}, A_{22}, A_{23}\}$ ={ Professional Construction, Technological Innovation, Teaching and Training}, $A_3=\{A_{31}, A_{32}, A_{33}\}$ ={Enterprise Benefit, School Benefit, Student Satisfaction}. The set of indicators at the three levels are denoted as sets, respectively:

$$\begin{aligned} &A_{11}=\{A_{111}, A_{112}, A_{113}, A_{114}\} \\ &A_{12}=\{A_{121}, A_{122}, A_{123}, A_{124}\} \\ &\cdots \\ &\cdots \\ &\cdots \\ &A_{33}=\{A_{331}, A_{332}, A_{333}\} \end{aligned} \tag{10}$$

2) Determination of evaluation rating set. The rating set is the set of comments composed of all possible judgment results made by the evaluation subject on the object, which is set as a set $V=\{V_1, V_2, V_3, V_4, V_b\}$, and the specific ratings can be described in the appropriate language based on the content of the evaluation, and all the influencing factors are taken into consideration in order to obtain the appropriate fuzzy comprehensive evaluation final result. It is necessary to consider all the influencing factors comprehensively to get the appropriate fuzzy comprehensive evaluation finalization. In this paper, the set of grades can be determined as $V=\{V_1, V_2, V_3, V_4, V_5\}$ ={excellent, good, fair, qualified, unqualified}.

3) Determine the fuzzy relationship matrix. Factors, also known as indicators, are evaluated by a single factor, that is, by evaluating an indicator to determine the degree of affiliation of the evaluation object to the evaluation level, which is affected by a number of factors, which are to be synthesized to evaluate the evaluation level of this indicator. Evaluation of an object by an expert familiar with the field or an evaluator of higher education according to the definition of the set of evaluation levels, that is, to determine the degree of affiliation of the object of evaluation to the rating level V, in order to construct a fuzzy relationship matrix R. Where the affiliation degree is calculated by the formula:

$$r = \frac{\text{Number of experts who rated a factor at a certain level}}{\text{Total number of experts}} \tag{11}$$

The fuzzy relationship matrix R obtained is as follows:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1b} \\ r_{21} & r_{22} & \cdots & r_{2b} \\ \vdots & \vdots & \vdots & \vdots \\ r_{a1} & r_{a2} & \cdots & r_{ab} \end{bmatrix} \tag{12}$$

4) Determine the weight of evaluation indicators. It is not possible to judge the evaluation level of the evaluation object only by the fuzzy relationship matrix, and the status and role of each indicator in the evaluation index system are different, so it is necessary to measure the importance of each indicator through the weights. The role of weights for fuzzy comprehensive evaluation is crucial, the same set of indicators, due to the different weights will make the results produce great differences. In this paper, intuitionistic fuzzy hierarchical analysis is used to determine the weight of each evaluation index, and the results of the evaluation index weights are calculated by Excel and Yaahp software.

5) Determine the fuzzy comprehensive evaluation model. Multiply the weight vector W with the fuzzy relationship matrix R to get the fuzzy comprehensive evaluation result vector B, which proves the proportion of evaluation objects on each evaluation level. Namely:

$$B = W * R = (w_1, w_2, \cdots, w_a) * \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1b} \\ r_{21} & r_{22} & \cdots & r_{2b} \\ \vdots & \vdots & \vdots & \vdots \\ r_{a1} & r_{a2} & \cdots & r_{ab} \end{bmatrix} = (b_1, b_2, b_3, \cdots, b_n) \tag{13}$$

Where b_j denotes the degree of affiliation of the evaluated object to the elements in the evaluation level set from the overall view.

6) Analyze the fuzzy comprehensive evaluation results. According to the above calculation, the fuzzy comprehensive evaluation result vector $B = \{b_1, b_2, b_3, b_4, \ldots, b_n\}$, according to the principle of the maximum affiliation, which factor in vector B has the largest value, it means that the object to be evaluated is subordinate to the grade. The value of vector B should also be normalized, calculated to obtain the evaluation results of the performance of university-enterprise integration of hotel management majors in higher vocational colleges and universities, and it is also necessary to analyze the evaluation results obtained by combining the actual development of university-enterprise integration to comprehensively judge the current level of performance of university-enterprise integration of hotel management majors in higher vocational colleges and universities.

2.3.2. Evaluation System Applied to Horizontal Comparison of Higher Education Institutions. Among the higher vocational colleges and universities of a province under the "Innovation and Strengthening Schools Project", three sample colleges and universities were selected and numbered as Institution 1, Institution 2 and Institution 3 respectively. Through the official website of each institution and the annual report on education quality made public to the society, based on the evaluation system constructed in the previous period, the data related to "investment in school-enterprise integration, process of school-enterprise integration, and effectiveness of school-enterprise integration" of the hotel management major of each institution in 2024 will be collected. Then based on the fuzzy comprehensive evaluation method, using the standardized processing mathematical model and the fuzzy comprehensive evaluation mathematical model, the evaluation indexes of the indicators at all levels are calculated, and the radar chart of 2024 school-enterprise integration performance evaluation of hotel management majors in the sample colleges and universities is plotted as shown in Figure 3.

The comparative analysis of radar charts can measure the performance level of university-enterprise integration of hospitality management majors in each institution. Among the three sample institutions, the comprehensive evaluation indexes from high to low are: Institution 1, Institution 3 and Institution 2, with corresponding index values of 0.89, 0.61 and 0.34, which are consistent with the ranking of the assessment and evaluation results of the 2024 "Innovation and Strengthening of Schools Project" of higher vocational education announced by the Department of Education of the province. Institution 1 is significantly higher than the other two institutions in terms of "investment in university-enterprise integration". It is not enough to rely solely on schools for education funding and resources. The key to the integration of schools and enterprises is the joint training and collaborative education of schools and enterprises.

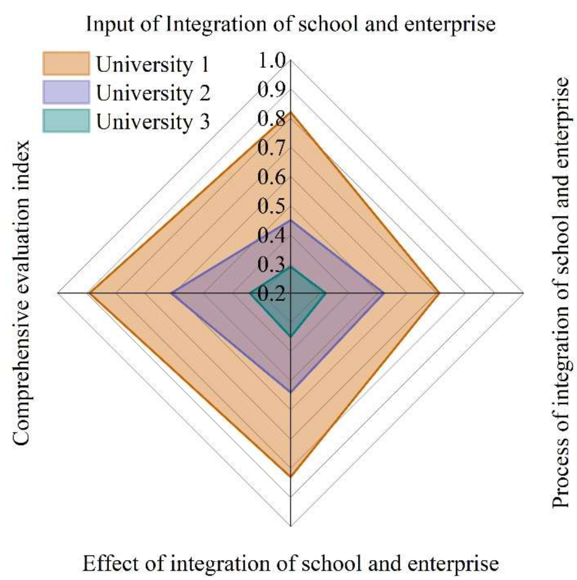

Fig. 3. School and enterprise integration performance evaluation of sample institutions

2.3.3. Longitudinal Comparison of Evaluation Systems Applied to Higher Education Institutions. Taking Institution 3 as the research object, a longitudinal comparison of the performance of school-enterprise integration of its hotel management major in 2021-2024 is conducted based on the fuzzy comprehensive evaluation method. By consulting the data collection and management platform of talent cultivation status and the annual report of education quality, we obtained the relevant data on the school-enterprise integration of the hotel management major of this institution in 2021-2024, calculated the evaluation indexes of indicators at all levels by using the mathematical model, and drew the radar chart of the evaluation of the performance of the school-enterprise integration of the hotel management major of Institution 3 in 2021-2024, which is shown in Fig. 4.

The overall trend of university-enterprise integration performance of this institution for the years 2021-2024 is upward, and the years are in descending order according to the comprehensive evaluation index: 2023, 2024, 2022, and 2021, which correspond to index values of 0.78, 0.61, 0.37, and 0.25, respectively.Through the interviews with a large number of stakeholders, this paper found that the result is consistent with their subjective judgment. It is understood that in 2023, the college will cooperate with a number of large enterprises to carry out "modern apprenticeship", "top post internship", "order training" and "science and technology correspondent" and other mutually beneficial and win-win cooperation models between schools and enterprises. Schools and enterprises increase investment in funds, equipment and teachers, and jointly implement the process of school-enterprise integration. The number of graduates retained in cooperative enterprises is relatively large, the satisfaction of enterprises and students is high, and the integration of schools and enterprises has achieved good benefits.

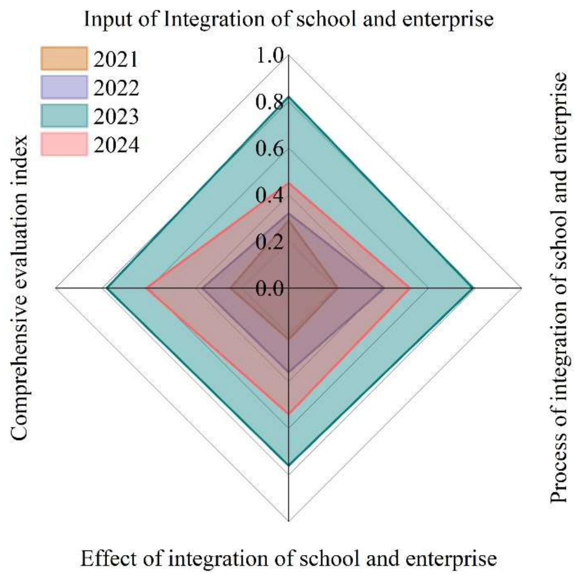

Fig. 4. Performance evaluation of the integration of school and enterprise in university 3

3. Analysis of fsQCA-based collaborative education path of higher vocational colleges and universities and enterprises

On the basis of constructing the performance evaluation system of school-enterprise integration for higher vocational hotel management majors, this chapter adopts the fuzzy set qualitative comparative analysis method (fsQCA) to explore the school-enterprise collaborative education path of higher vocational colleges and universities and provide path references for the school-enterprise collaborative development of hotel management majors.

3.1. *Selection of research methodology*

The fuzzy set qualitative comparative analysis method (fsQCA) [34] used in this chapter is an evolution of the qualitative comparative analysis method (QCA), which requires the use of fuzzy set theory to calibrate the relevant data, and the value range is allowed to be any value from "0" to "1", which is used to identify the degree to which a condition or factor can be observed, not only to explore the relationship between antecedents and consequences, but also to explore the complexity between multiple factors.

The construction of university-enterprise collaborative parenting cultivation mode in higher vocational colleges and universities is affected by various factors, and there is no absolute optimal solution for the path of cultivation mode, and the factors will lead to different combinations of cultivation paths. On the basis of the literature research on the influencing factors, cultivation mode and performance evaluation of collaborative cultivation, and interviews with some enterprises and colleges and universities, the analysis reveals that there are certain shortcomings in the existing research: firstly, the existing research seldom researches the factors and their interconnections, and secondly, school-enterprise collaborative cultivation projects have neglected the influence of the enterprise scale and the disciplinary and professional attributes of the university on the effect of cultivation. Based on this, this paper argues that it is necessary to combine the scale of different enterprises and the disciplinary characteristics of higher vocational colleges and universities to explore the influencing factors and their interconnections of school-enterprise collaborative parenting, in order to construct the cultivation mode and path of school-enterprise collaborative parenting in higher vocational colleges and universities. In terms of research methods, traditional methods such as factor analysis and regression analysis are unable to discuss the holistic role of the combination of influencing factors. Another consideration is the ambiguity of the relationship between the influencing factors of school-enterprise collaborative cultivation and the effectiveness of collaborative cultivation programs, which needs to allow the use of numbers from 0 to 1 to observe the degree of the role. Therefore, this paper adopts the method of fsQCA.

3.2. Construction of Research Model and Interpretation of Variables

On the basis of literature research and interviews, this paper adopts the combination of questionnaire survey and fsQCA method to select 4 factors affecting the effectiveness of university-enterprise collaborative education programs in higher vocational colleges and universities, namely, enterprise scale, discipline type of universities, pre-project input and project implementation process, and constructs a research model as shown in Figure 5. The research model mainly includes 4 conditional variables of enterprise scale, discipline type, pre-project input and project implementation process, and 1 outcome variable of the effectiveness of the collaborative education program. The five variables are now explained:

1) Enterprise size. Among the enterprises participating in collaborative education, there are differences in enterprise size. In the paper, enterprise size is divided into two categories: enterprises with more than 500 employees and enterprises with less than 500 employees, in order to distinguish the relationship between enterprises of different sizes and other independent variables when participating in the university-enterprise collaborative parenting program, as well as the impact on the effectiveness of the program.

2) Discipline type. The disciplines involved in the collaborative education programs carried out by schools and enterprises are different. In this paper, economics, law, management, etc. are categorized as liberal arts disciplines, and science and engineering, etc. are categorized as science and technology disciplines, in order to distinguish the different impacts of different types of disciplines on the effectiveness of university-enterprise collaborative education programs.

3) Pre-program Input. Before the university-enterprise collaborative education program is carried out, it is necessary for the government, universities and enterprises and other parties to do a good job in preparing for the program. It mainly includes policy support, financial input, practice bases, university-enterprise collaborative education mentors, technical support from research institutes or industrial parks, and formal processes.

4) Project implementation process. During the implementation of the university-enterprise collaborative education program, the university and the enterprise need to establish a “dual tutor system” and actively communicate and exchange. Only through the joint participation of the enterprise, the university and the third party, and active cooperation to promote the development and implementation of the project, can we guarantee that the project will have a certain degree of effectiveness.

5) Effectiveness of collaborative education program. The effectiveness of the collaborative education program is mainly reflected through four aspects: first, whether the collaborative education program has achieved the expected goals, second, whether the university and enterprises will continue to cooperate, third, whether the practical ability of the students participating in the program is improved, and fourth, whether the program stakeholders have a high degree of satisfaction with the education.

The effectiveness of school-enterprise collaborative parenting programs in higher vocational colleges and universities is often not contributed by a single factor, but by a combination of several factors. This study takes the questionnaire data as a sample, analyzes the combination of multiple factors that can improve the effectiveness of school-enterprise collaborative parenting programs, and explores the mode and path of school-enterprise collaborative parenting cultivation in higher vocational colleges and universities.

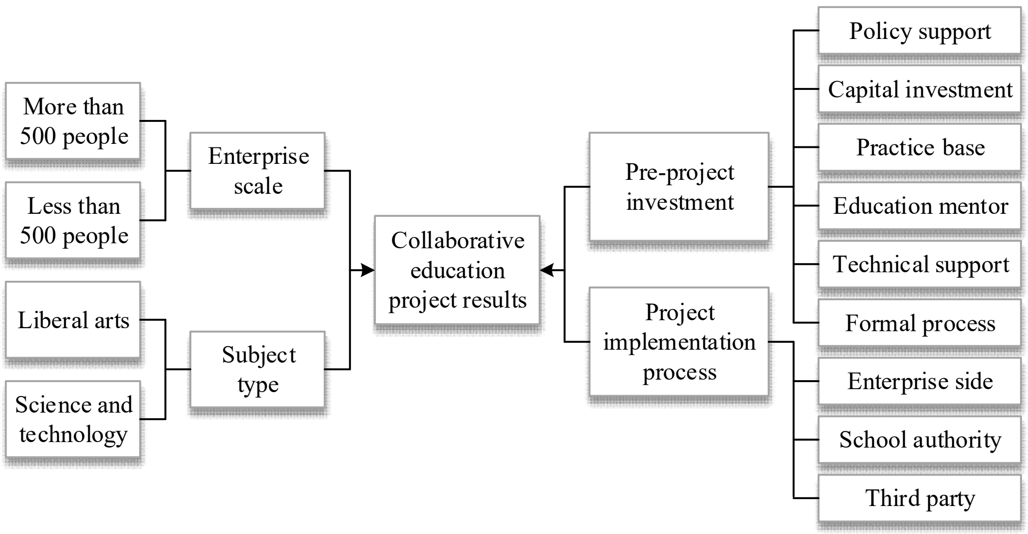

Fig. 5. Theoretical research model

3.3. Questionnaire design and data collection

3.3.1. Questionnaire design. Relevant literature and expert interviews are reviewed, and the questionnaire for school-enterprise collaborative education in higher vocational colleges and universities is formulated according to the selected condition variables and outcome variables. The questionnaire is mainly composed of two parts: basic information items and measurement items. The basic information items were set as skip-choice questions, mainly for enterprises and higher vocational colleges, which were used to understand the basic situation of both enterprises and colleges in the university-enterprise collaborative education program, while the 24 measurement questions were used to observe the preliminary input, implementation process and program effectiveness of the university-enterprise collaborative education program.

3.3.2. Data collection. The research data come from 16 different cities, mainly involving enterprises of different natures, liberal arts and science and technology higher vocational colleges and universities. Taking enterprises and higher vocational colleges and universities participating in university-enterprise collaborative education in higher vocational colleges and universities as the survey object, with the help of an online questionnaire platform, a total of 96 electronic questionnaires were distributed and 95 questionnaires were recovered, with 87 valid questionnaires, and the effective recovery rate was about 91.6%.

3.4. Empirical analysis

3.4.1. Data calibration and variable assignment. When fsQCA method is used, data calibration refers to the process of assigning set affiliation scores to the cases, the key lies in the fact that the researchers need to base on their own existing factual experience and theoretical knowledge, combine the characteristics of the research situation and the obtained data, make judgment on the critical value and give the corresponding justification, and the division of the set affiliation in the calibration requires three critical values of full affiliation, intersection point and incomplete affiliation.

For data calibration, this study used questionnaire data derived from Likert scale and used 95% percentile, 50% percentile and 5% percentile of each variable as its full affiliation, crossover and full non-affiliation points, respectively. At the same time, the crossover points were slightly adjusted to avoid the crossover values being ignored.

This paper uses the above method to calibrate the data for the three variables of project pre-input, project implementation process and project effectiveness, and the specific calibration results finally obtained are shown in Table 4.

Table 4. fsQCA data calibration

Variable	Full membership	Crossing point	Completely unaffiliated
Pre-project investment	4.1	3.01	2.2
Project implementation process	4.1	3.02	2.3
Project effectiveness	4.4	3.02	2.24

Conditional variables enterprise size and discipline type are dichotomous variables and do not need to be calibrated, and their assignment criteria are as follows:

1) According to the number of employees in the enterprise to determine the size of the enterprise, the number of employees <500 is a small enterprise and assigned the value of 0, the number of employees >500 is a large enterprise and assigned the value of 1.

2) According to the name of the discipline or major filled in by the questionnaire filler to determine the type of discipline, basic disciplines are assigned the value of 0, and applied disciplines are assigned the value of 1. Based on the data calibration and assignment criteria of four conditional variables and one outcome variable, the collected questionnaire data are assigned to get the original logical truth table, and imported into the software fsQCA3.0 to analyze the calculations.

3.4.2. Necessity analysis of a single conditional variable. After calibrating the data, the sufficiency of individual condition variables should be analyzed first. In the fsQCA method, the sufficiency analysis of individual condition variables is mainly judged by consistency and coverage. The formula for consistency is as follows:

$$Consistency(X_i \le Y_i) = \Sigma[\min(X_i, Y_i)] / \Sigma X_i \tag{14}$$

Where, X is the condition variable and Y is the outcome variable.

If the consistency is higher, it means that the condition variable is more sufficient for the outcome variable. When the value of consistency is greater than 0.9, the condition variable is considered sufficient for the outcome variable.

Coverage is used to measure the empirical relevance of a necessary condition, i.e., the explanatory strength of that necessary condition for the outcome variable, and is calculated as follows:

$$Consistency(X_i \le Y_i) = \Sigma[\min(X_i, Y_i)] / \Sigma Y_i \tag{15}$$

A larger value of coverage indicates a greater empirical relevance of the necessity and a stronger explanation of the outcome variable.

The truth table was imported into the fsQCA3.0 software and the positive and negative values were taken once for each of the four conditional variables, and the results of the necessity analysis were obtained as shown in Table 5. Where ~ represents the "not" of logical operation. When the school-enterprise integration program achieves high performance, the consistency of all the conditional variables does not reach 0.9, which indicates that none of the conditional variables can be used as a necessary condition for the school-enterprise integration program to achieve high performance. Therefore, it is necessary to find a combination of conditional variables that can reasonably explain the high performance of school-enterprise integration projects, so as to explain how the synergistic elements of school-enterprise integration can be combined to realize good synergistic effects under different realistic situations.

Table 5. The results of the necessity analysis of individual conditions

Condition variable		School and enterprise integration project achieved high performance	
		Consistency	Coverage
Enterprise scale	x1	0.635274	0.614563
	~x1	0.384925	0.601754
Subject type	x2	0.542891	0.580262
	~x2	0.475178	0.643105
Pre-project investment	x3	0.805153	0.885819
	~x3	0.542159	0.713467
Project implementation process	x4	0.782461	0.886539
	~x4	0.532473	0.667928

3.4.3. Sufficiency analysis of combinations of conditional variables. Sufficiency analysis of combinations of condition variables can be divided into 3 main steps: constructing the truth table, refining the truth table and analyzing the truth table. Constructing and refining the truth table requires first determining the case frequency threshold and consistency threshold. In this study, the case frequency threshold is set to 1 and the consistency threshold is set to 0.8. Based on this, the calibrated fuzzy set affiliation score matrix can be converted into a threshold-screened truth table.

Using the software fsqca3.0 to perform the standard analysis of the truth table, the complex, intermediate and parsimonious solutions of the combination of conditional variables can be obtained when the outcome variable is the school-enterprise integration program to achieve high performance. The results of the condition variable combination analysis are shown in Table 6. It can be seen that the groupings of complex and intermediate solutions are consistent and have the same values of coverage and uniqueness.

Table 6. Results of conditional variable combination analysis

Type	Conditional combination	Original coverage	Unique coverage	Consistency
Complex solution	~x1*x3*x4	0.291285	0.203472	0.949254
	x1*x2*x3	0.276517	0.053849	0.912437
	x1*x2*x4	0.413961	0.026813	0.950814
	~x1*x2*x3*x4	0.120734	0.028146	0.971738
	x1*x2*x3*x4	0.210536	0.038161	0.920543
	Result coverage: 0.807156, Result consistency: 0.924185			
Intermediate solution	~x1*x3*x4	0.291285	0.203472	0.949254
	x1*x2*x3	0.276517	0.053849	0.912437
	x1*x2*x4	0.413961	0.026813	0.950814
	~x1*x2*x3*x4	0.120734	0.028146	0.971738
	x1*x2*x3*x4	0.210536	0.038161	0.920543
	Result coverage: 0.807156, Result consistency: 0.924185			
Reduced solution	x4	0.782451	0.263581	0.886315
	x1*x3	0.479536	0.045293	0.894458
	~x1*x2	0.182453	0.035286	0.647932
	x2*x3	0.341562	0.001825	0.884259
	Result coverage: 0.907138, Result consistency: 0.815367			

In this paper, we focus on analyzing the intermediate solution and synthesizing the parsimonious solution to make judgments on the core conditions, and obtain the results of the group analysis as shown in Table 7. The large circle in the table indicates the core condition, where ● indicates that the core condition exists and ⊗ indicates that the core condition is missing. The small circle indicates the auxiliary conditions, where ● indicates the existence of auxiliary conditions and ⊗ indicates the absence of auxiliary conditions. The "blank" indicates that the condition is irrelevant in the configuration.

As can be seen from the table, there are five effective paths to achieve high performance in school-enterprise integration programs. The consistency of each path is greater than the empirical threshold value of 0.85, and the total consistency value is as high as 0.924185, which indicates that the empirical analysis of this study has high validity. In addition, the total coverage value is 0.807156, which means that the overall coverage of 80% of the sample is high. Comparing the coverage indexes of the above five paths, Path 3 has the highest original coverage, explaining more than 41% of the resultant variable coverage, i.e., more than 40% of the school-enterprise integration projects have obtained high project effectiveness through this path, which indicates to a certain extent that the industrial parties of the current school-enterprise integration projects are still dominated by large enterprises. The original coverage of paths 1, 2, 4, and 5 is 29%, 28%, 12%, and 21%, respectively, indicating the diversity of paths through which school-enterprise integration projects achieve high performance.

Table 7. Results of configuration analysis

Condition variable	Configuration solution				
	Path 1	Path 2	Path 3	Path 4	Path 5
Enterprise scale	⊗	●	●	⊗	●
Subject type		●		⊗	⊗
Pre-project investment	●	●	●	●	
Project implementation process	●				●
Original coverage	0.29129	0.27652	0.41396	0.12073	0.21054
Unique coverage	0.20347	0.05385	0.02681	0.02815	0.03816
Consistency	0.94925	0.91244	0.95081	0.97174	0.92054
Overall consistency	0.924185				
Total coverage	0.807156				

3.4.4. Collaborative path analysis. Path 1 shows that when small businesses and different disciplines carry out school-enterprise integration projects, the school-enterprise integration projects achieve high performance when the project implementation process is smooth and the pre-project investment is sufficient. The original and unique coverage of this path is 0.29129 and 0.20347, respectively, indicating that it explains about 29% of the cases in which school-enterprise integration projects achieve high performance, and about 20% of these cases can be explained by this path only. The consistency of this pathway is about 0.95, suggesting that when small businesses collaborate with all types of disciplines, focusing on initiatives during the implementation of the program, along with sufficient upfront investment, the effectiveness of the program can be guaranteed.

Path 2 shows that when large enterprises and applied disciplines carry out university-enterprise integration projects with sufficient upfront investment, the university-enterprise integration projects achieve high performance. This path explains about 27% of the cases where the university-enterprise integration program achieves high performance, and about 5% of the cases can only be explained by this path. Meanwhile, the consistency of this path is about 0.91, indicating that when large enterprises and applied disciplines cooperate, the projects can achieve high performance because the purpose is relatively clear, i.e., joint research and development and the formation of technological results, and both parties are likely to have previous experience in university-enterprise cooperation, focusing on the preparatory work.

Path 3 shows that when large enterprises and applied disciplines carry out university-enterprise fusion projects, the project implementation process is smooth and there is sufficient investment in advance of the project, and the university-enterprise fusion project achieves high performance. The original and unique coverage of this path is 0.41396 and 0.02681, respectively, indicating that it can explain about 41% of the cases in which the university-enterprise integration projects achieve high performance, of which about 3% can be explained by this path only. The consistency of this pathway is about 0.95, suggesting that when large firms collaborate with applied disciplines, they can also contribute to the high performance of school-business integration programs when they have a smooth implementation process coupled with adequate preparation.

Path 4 shows that when small firms and basic disciplines carry out school-business integration projects, the project motivation of smooth implementation process and adequate project preparation leads to high performance of school-business integration projects. This path explains about 12% of the high performance cases of school-enterprise integration programs, and about 3% of the cases are only explained by it. Meanwhile, the consistency of this path is about 0.97, which indicates that when small enterprises cooperate with basic disciplines, the projects can also achieve good results if their implementation process is normal under the premise of sufficient upfront investment.

Path 5 shows that when large enterprises and basic disciplines carry out university-enterprise integration projects, the university-enterprise integration project achieves high performance when the project has sufficient upfront inputs and the project implementation process is perfect. According to the original and unique coverage of this path of 0.21054 and 0.03816 respectively, it can explain about 21% of the cases of high performance of school-enterprise integration programs, and about 4% of these cases can be explained by this path only. The consistency of this path is about 0.92, indicating that on the premise of having sufficient upfront investment, when large enterprises carry out school-enterprise integration projects with basic disciplines, they focus on improving various measures in the process of project implementation to ensure that the whole process of talent cultivation involves the participation of both the university and the enterprise, and that the projects are able to achieve high performance.

4. Conclusion

On the basis of realizing the construction and application of school-enterprise integration performance evaluation system for higher vocational hotel management majors, this paper explores the effective path of school-enterprise collaborative education.

First, the IPO evaluation model is introduced to construct the evaluation index system of school-enterprise integration for higher vocational hotel management majors from the three dimensions of school-enterprise integration input, school-enterprise integration process and school-enterprise integration effectiveness, which includes a total of 9 secondary and 34 tertiary indicators. At the same time, the fuzzy intuitionistic hierarchical analysis method (IFAHP) was used to calculate the weights of the indicators, and the results showed that the process of school-enterprise integration was the most important evaluation dimension, followed by the input of school-enterprise integration and the effectiveness of school-enterprise integration. Then, by using the fuzzy comprehensive evaluation method to make horizontal and vertical comparisons of the performance of school-enterprise integration in the sample institutions, the credibility and operability of the evaluation system are verified, and the deepening of school-enterprise integration cannot be separated from the inputs of capitals, equipments, and faculties, and the institutional mechanism of school-enterprise cooperation that involves the coeducation of talents, co-management of the process, sharing of results, and sharing of responsibilities.

Secondly, this paper analyzes the overall impact of different combinations of elements on the effectiveness of the school-enterprise integration program, and extracts five high-performance paths for school-enterprise integration of talent cultivation. These paths highlight the group effect of talent cultivation in colleges and universities, on the one hand, expanding the theoretical basis for the context of talent cultivation, identifying effective paths for school-enterprise integration projects with different enterprise scales and different disciplinary attributes, and on the other hand, providing realistic references for the design of the system of school-enterprise integration talent cultivation for higher vocational hotel management majors and encouraging the government, enterprises and colleges and universities to customize and re-design the relevant system according to the backgrounds of the parties involved in the school-enterprise integration project customization and characteristic redesign, so as to effectively enhance the effectiveness of talent cultivation.

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