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Research on the Evaluation System of Urban Industry Education Joint Venture Based on Fuzzy Comprehensive Evaluation

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Abstract

This study presents a comprehensive methodology for constructing and evaluating the effectiveness of municipal industry-education consortiums. The core objective is to establish an evaluation index system that quantitatively and qualitatively measures the "compatibility" between consortium construction activities and talent cultivation outcomes. the study outlines implementation strategies, emphasizing deep integration of consortium top-level design into regional development strategies. Key recommendationsincludeestablishingspecializedplanningteams, creating"government-administration-enterprise-school" linkage mechanisms, implementing dynamic industry monitoring and talent forecasting, and synchronizing annual consortium plans with regional industrial development (exemplified by the Guangzhou Baiyun Airport Consortium). This systematic approach aims to ensure the consortium effectively supplies human resources and drives technological innovation for regional economic growth.

Keywords

Effectiveness Evaluation System:Municipal Industry-Education ConsortiumEffectiveness Evaluation SystemTalent Cultivation.

1. Method for Constructing A Comprehensive Evaluation System for The Effectiveness of The Construction of The Municipal Industry Education Consortium

1.1. Guiding ideology for constructing a comprehensive evaluation index system for the effectiveness of the construction of urban industry education consortia

Building a comprehensive evaluation index system for the effectiveness of the construction of a city wide industry education consortium is essentially using specific indicators to quantitatively and qualitatively describe whether the construction of the virtual simulation teaching system in civil aviation higher vocational colleges can effectively support talent cultivation. Each indicator in the index system is used as a "perspective" to measure, and through the interaction between indicators, the relationship between the impact of the virtual simulation teaching system on the entire process of talent cultivation can be "visible" and "tangible", thus enabling precise control of the entire process of virtual simulation system construction. Due to the fact that the construction of virtual simulation teaching system in civil aviation higher vocational colleges involves multiple levels such as government, enterprises, universities, industry associations, and research institutes, it is a systematic and complex operation process that requires a clear guiding ideology as the basis.

Therefore, the guiding ideology for the construction of the comprehensive evaluation index system for the effectiveness of the construction of the municipal industry education consortium is to take the evaluation of the compatibility between talent cultivation and virtual simulation system construction as the rough focus, combined with the special nature of talent cultivation

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in civil aviation higher vocational education and the technical nature of virtual simulation teaching system construction, following the principles of combining independence and relevance, comprehensiveness and emphasis, dynamic and static, quantitative and qualitative, objectivity and subjectivity, and constructing indicators according to the perspective of system theory and system analysis method, making comprehensive judgments and evaluations on the virtual simulation teaching system and talent cultivation effects, benefits, effects, etc., providing important basis for optimizing talent cultivation modes and methods based on virtual simulation technology, To provide support for virtual simulation technology as a means of promoting teaching reform in civil aviation higher vocational colleges.

1.2. Design principles for the comprehensive evaluation index system of the construction effectiveness of the municipal industry education consortium

Scientificity. Scientificity is the primary condition for constructing a comprehensive evaluation index system for the effectiveness of the construction of urban industry education consortia, and is a key link in ensuring the effective evaluation of the quality of fit. The scientificity of indicator setting is mainly reflected in two aspects: firstly, the indicator setting should comply with the inherent requirements and laws of talent cultivation in civil aviation higher vocational education; The second is that the meaning, classification criteria, and calculation methods of indicators should be fair and objective, and can objectively and comprehensively reflect the true relationship between various indicators. Only in this way can the established indicator system truly reflect the situation of consortium construction[1].

Systematic. The comprehensive evaluation index system for the construction effectiveness of the municipal industry education consortium is a specific tool and means for describing and reflecting various operating conditions, processes, and results in this system structure. Therefore, the establishment of a comprehensive evaluation index system for the effectiveness of the construction of the municipal industry education consortium must comply with systematic principles to ensure that all types of entities involved in talent cultivation form a whole. The systematic setting of indicators mainly reflects the hierarchical order in structure. The response of the indicator system is an organic combination of multiple types of indicators with clear hierarchy, structure, and relationships. The indicator relationships are clear, reflecting the performance of the indicators from different perspectives.

Pertinence. Establishing a comprehensive evaluation index system for the construction effectiveness of urban industry education consortia is a huge project, but the constructed index system cannot cover all attributes and needs comprehensively. Therefore, in the process of constructing an indicator system, it is necessary to grasp the main issues related to talent cultivation for comprehensive evaluation, carefully screen for the main issues, construct an indicator system, avoid duplication, and make every effort to select representative comprehensive and important indicators.

Operability. The purpose of constructing a comprehensive evaluation index system for the effectiveness of the construction of urban industry education consortia is not only theoretical research, but also to use this index system, adopt a combination of quantitative and qualitative analysis methods, construct an evaluation model, and conduct an overall evaluation and control of the effectiveness of virtual simulation teaching. Therefore, in the process of constructing an indicator system, attention should be paid to evaluating whether each indicator in the indicator system can be quantitatively analyzed or whether quantitative results can be obtained through simple conversion using relevant methods. If the indicator system involved cannot obtain correct data or even uses fabricated data for evaluation due to its inoperability, the evaluation results will be divorced from the actual situation and lose their practical value.

Comparability. The indicators at the same level in the comprehensive evaluation index system for the construction effectiveness of the municipal industry education consortium should meet

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the requirements of comparability, that is, have the same measurement range, measurement caliber, and measurement method. The values of the indicators should be relative, and absolute values should be avoided as much as possible. This allows the indicators to reflect the actual situation and facilitate comparison of advantages and disadvantages.

2. The Basic Idea of Constructing and Improving The Comprehensive Evaluation Index System for The Effectiveness of The Construction of The Municipal Industry Education Consortium

The indicator system reflects the degree of fit of the consortium in talent cultivation from multiple levels and perspectives. The characteristic of the indicator system is that there is a strong internal connection between multiple indicators that make up the indicator system. Indicators are not randomly stacked, but are combined together according to a certain structural relationship. Therefore, before constructing the comprehensive evaluation indicator system for the construction effectiveness of the urban industry education alliance, it is necessary to divide the main body and influencing factors of virtual simulation construction, and establish an evaluation indicator system that conforms to multiple perspectives and focuses.

Emphasize the comprehensive evaluation role of qualitative indicators in reflecting the degree of fit of the consortium in talent cultivation. Usually, in the process of designing indicator systems, we focus more on quantitative indicators, and abandon qualitative indicators due to the lack of corresponding quantitative standards. However, these qualitative indicators often reflect and play a decisive role. Therefore, in the process of constructing a comprehensive evaluation index system for the effectiveness of the construction of the urban industry education alliance, it is necessary to add corresponding qualitative indicators as much as possible, and at the same time, quantify the qualitative indicators to achieve quantitative management of the qualitative indicators.

Combining descriptive and evaluative indicators. Descriptive indicators are the fundamental part of the comprehensive evaluation index system for the construction effectiveness of urban industry education consortia. Their purpose is to comprehensively and systematically record and describe the impact of virtual simulation system construction on teaching, and reflect the overall operation status of talent cultivation. The descriptive indicator system is the foundation for the comprehensive evaluation of the effectiveness of the construction of the urban industry education alliance. Only by laying this foundation can a complete evaluation indicator system be established. The establishment of the evaluation indicator system should be based on the descriptive indicator system, and the evaluation task should be completed with as few indicators as possible, so that the evaluation indicators can not only objectively reflect the problem, but also obtain more accurate data. Only by combining these two types of indicators can we fully reflect whether the consortium has a positive impact on talent cultivation[2][3].

3. Construction of A Comprehensive Evaluation Index System for The Effectiveness of The Construction of The Municipal Industry Education Consortium

3.1. Preliminary Design of Comprehensive Evaluation Index System for the Construction Effectiveness of Urban Industry Education Joint Venture

This study follows the following two steps to establish a comprehensive evaluation index system for the construction effectiveness of urban industry education consortia: the first step is the design and survey of an open-ended questionnaire. Using the method of analyzing the characteristics of work behavior, we will deeply analyze the typical behavioral characteristics

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that constitute the comprehensive evaluation elements of the construction effectiveness of the city's industry education alliance, summarize specific characteristic indicators, analyze and interpret the indicators, summarize complete evaluation items, and form a secondary evaluation index system based on the evaluation items; The second step is expert discussion. A panel of 10 experts in the field of education, 10 senior management personnel in the aviation industry, and 10 frontline practitioners in the aviation industry conducted a discussion. The experts identified and judged the 70 specific indicators summarized and organized in the first step, deleted 20 indicators with repeated content and poor meaning, and converted the remaining 18 indicators that were ambiguous, difficult to operate, and difficult to understand into project indicators with clear meaning, easy understanding, and operability, forming a comprehensive evaluation index system of 45 indicators for the construction effectiveness of urban industry education consortia[4].

3.2. Empirical screening of comprehensive evaluation indicators for the construction effectiveness of urban industry education consortia

(1) Membership analysis of comprehensive evaluation indicators for the construction effectiveness of urban industry education consortia

In order to gain a deeper understanding of the opinions of experts on the preliminary screening evaluation indicators, based on the collected expert consultation form and relevant concepts of fuzzy mathematics, a membership analysis was conducted on the evaluation indicators. Membership degree refers to the degree to which an element belongs to a certain set. The comprehensive evaluation of the effectiveness of the construction of the urban industry education alliance is a vague concept, and the evaluation index system can be regarded as a set, with each evaluation index regarded as an element in the set. Assuming that on the i-th evaluation indicator, the total number of times experts have selected it is, that is, a total of experts believe that the indicator is the most important indicator for evaluating the comprehensive evaluation of the effectiveness of the construction of the city's industry education alliance. If the effective consultation list is N, then the membership degree of this evaluation indicator is. When the value of is large, it represents that the indicator belongs to a fuzzy set to a large extent, that is, the evaluation indicator is important in the evaluation system and can be retained and carried out in the next round of evaluation indicator system; Reproduction, delete this evaluation indicator.

(2) Analysis of the discriminatory ability of comprehensive evaluation indicators for the construction effectiveness of urban industry education consortia

The discriminative power of evaluation indicators refers to the ability of evaluation indicators to distinguish differences in the characteristics of the evaluated object. In the process of constructing the comprehensive evaluation index system for the construction effectiveness of the (1) municipal industry education consortium, this project conducted a discriminative analysis of the indicators to distinguish the quality of virtual simulation practice teaching in civil aviation higher vocational colleges based on the evaluation indicators. If the scores of the surveyed subjects on a certain evaluation index are basically consistent, it can be considered that the discriminative power of the evaluation index is weak, and it is unable to judge and identify the virtual simulation practice teaching of civil aviation higher vocational colleges; On the contrary, if there is a significant difference in the scores of the surveyed subjects on a certain evaluation index, then the evaluation index has strong discriminative ability and can determine whether it is to identify the evaluation effect of virtual simulation practice teaching in civil aviation higher vocational colleges.

(3) Correlation analysis of comprehensive evaluation indicators for the effectiveness of the construction of the municipal industry education consortium

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After the above two steps of screening, there are still some indicators in the comprehensive evaluation index system for the construction effectiveness of the third round of urban industry education consortium that have certain correlations. This correlation can lead to the repeated use of information about the evaluated indicators, thereby reducing the scientificity and rationality of the evaluation results. To solve this problem, this project adopts correlation analysis for the indicators of the third round. Correlation analysis is the process of measuring the correlation between evaluation indicators, removing indicators with low discriminatory ability and high correlation with other indicators, in order to eliminate or reduce the adverse effects of these indicators that repeatedly reflect the evaluation object, and retaining the remaining indicators to form the fourth round of indicator system for the comprehensive evaluation of the effectiveness of the construction of the city's industry education alliance[5].

3.3. Reliability and validity testing of the comprehensive evaluation index system for the construction effectiveness of the municipal industry education consortium

(1) Reliability Analysis

This project uses split half reliability and internal consistency reliability to test the reliability of the comprehensive evaluation index system for the construction effectiveness of the municipal industry education consortium. Half fold reliability refers to dividing a test item into two halves according to odd and even items, integrating them separately, calculating the correlation coefficient between the scores of these two parts, and then determining the reliability coefficient of the entire measurement based on this. Based on the Spearman Brown formula, the half confidence coefficient can be directly calculated using SPSS statistical software. Based on the evaluation results, a half fold reliability of 0.931 was obtained. The internal consistency reliability reflects the relationship between internal questions in the test, examining whether each question measures the same content and traits. The Cronbach's alpha coefficient is commonly used to represent this.

(2) Validity Test

This project uses evaluation validity and construct validity to test the comprehensive evaluation index system for the effectiveness of the construction of the municipal industry education consortium. Evaluation validity refers to whether the measured indicators can accurately measure the desired transaction; Structural validity refers to the degree of correspondence between a certain structure reflected in the measurement results and the measured values. Factor analysis is usually used to test it. The test results show that, except for special indicators that have not implemented the dimension of project approval, most indicators have entered the theoretical division dimension and have a large degree of conformity, indicating high validity.

3.4. Comprehensive evaluation index system for the effectiveness of the construction of the municipal industry education consortium

Based on the above analysis and calculation process, a comprehensive evaluation index system for the effectiveness of the construction of the urban industry education consortium was finally formed, as shown in the table below.

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Table 3-1. Comprehensive Evaluation Indicators for the Construction Effectiveness of Municipal Industry Education Joint Venture

First level indicator	Secondary indicators	Third level indicators
Comprehensive evaluation of the effectiveness of the construction of the municipal industry education consortium	Deep integration of industry and education	Match between profession and industry
		The number and utilization rate of school enterprise joint construction training bases
		Proportion of enterprise participation in talent development plan formulation
		Proportion of "dual teacher" teachers
		Order based and customized training scale
		Number of certified enterprises integrating industry and education
	Talent training quality	Number of certified enterprises integrating industry and education
		Enterprise satisfaction (employer evaluation)
		Enterprise satisfaction (employer evaluation)
		Number/level of awards in skill competitions
		Average starting salary level for graduates
	Technology Innovation Services	Number of technology research and development projects in school enterprise cooperation
		Number of technology research and development projects in school enterprise cooperation
		Coverage rate of technical services for small and medium-sized enterprises
	Social contribution degree	Proportion of social training participants to current students
		Training and employment rate of key groups (veterans/migrant workers, etc.)
		Satisfaction rate of talent supply for key positions in regional industries

4. Comprehensive Evaluation of Urban Industry Education Consortium Based on Fuzzy Comprehensive Evaluation Method

Determine the evaluation factor set: Based on the evaluation index system, divide the given factors into evaluation factor sets U.

Establish an evaluation set for each factor: Based on the characteristics of the consortium, the current status of talent cultivation, and future industrial development needs, determine a comprehensive evaluation index for the effectiveness of consortium construction. Among them, 1 represents excellent, 2 represents good, 3 represents average, and 4 represents low.

Determine the weight matrix of each factor: For the determination of the weight of each factor, this study combines the Analytic Hierarchy Process and Matter Element Analysis. This can better enhance the objectivity of the weights of various indicators.

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Establish a second level factor fuzzy evaluation matrix R: Invite 1 expert from various industries, 1 outstanding employee from enterprises, 1 expert from industry associations, 1 expert from research institutes, and 1 expert from educational fields in universities to form an expert group. To evaluate the effectiveness of the joint venture construction, a binary logical judgment is made on whether a certain evaluation element belongs to or does not belong to the four evaluation levels. That is, when it is considered that the element belongs to the level, it is recorded as 1, otherwise it is recorded as 0. When calculating, P is the total number of experts participating in the evaluation, and P is the number of experts who select a certain element to belong to the level. Based on the judgment of the five experts, each evaluation matrix is obtained.

Calculate the fuzzy comprehensive evaluation result: After synthesis calculation, the second level comprehensive evaluation result is obtained. According to the principle of maximum membership degree, it can be concluded that the construction effect of the consortium is average.

5. Path and Strategy for the Construction of Urban Industry Education Joint Venture

The top-level design of the urban industry education alliance must be deeply integrated into the regional development strategic framework, and a linkage mechanism must be established with regional development planning, industrial development planning, and talent development planning. At the level of planning coordination, the consortium needs to establish a specialized planning research team to systematically analyze key elements such as industrial layout, technological routes, and talent demand in regional planning documents, and accurately match educational resource allocation with regional development strategies. Taking the "Guangzhou Baiyun Airport Municipal Industry Education Joint Venture" as an example, its professional cluster setting not only revolves around the civil aviation airport field, but also forward-looking layouts in future technology fields such as 5G communication and artificial intelligence, forming a professional system architecture of "core support+cutting-edge leadership". On the implementation path, the consortium should innovatively establish a planning and docking mechanism for the four party linkage of "government, administration, enterprises, and schools": establish a dynamic monitoring system for industrial development, and track the construction progress of key industrial projects in real time; Establish an industrial technology roadmap and predict the demand for key technical positions in the next 3-5 years; Carry out talent supply and demand forecasting and establish a dynamic adjustment mechanism for professional settings. This deep integration is not only reflected in the strategic planning linkage, but also implemented in specific action plans - the consortium formulates annual construction plans synchronized with the development of regional key industries every year, transforming major projects in industrial planning into specific indicators for talent cultivation, truly achieving the "resonance" of education planning and industrial planning. By establishing a systematic and institutionalized planning and coordination system, the comprehensive connection between the consortium's education chain and industry chain in terms of goals, pace, and space is ensured, providing precise human resource supply and technological innovation support for high-quality regional economic development.

6. Conclusion

This paper is dedicated to the evaluation of the effectiveness of the construction of urban industry education consortia, proposing a systematic evaluation index system and conducting a detailed analysis of the establishment process of the indicators, providing a reference for the development of subsequent urban industry education consortia.

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