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Research on the Dynamic Mechanism of the Integration of Industry and Education in Higher Vocational Education from the Perspective of Digital Intelligence Transformation

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Abstract: Based on the symbiosis theory, this study combs out the influencing factors of the driving force of industry-education integration in higher vocational education in the new era, uses SEM to conduct quantitative path analysis, and identifies the key points for mechanism optimization, thereby promoting the in-depth development of industry-education integration in higher vocational education in the context of digital intelligence, providing a useful reference for the digital intelligent transformation of vocational education and industry.

1. Introduction

With the continuous development of digital and intelligent technology, the industrial side talent demand pattern and the supply side training mode are constantly innovated. Therefore, the development of vocational education, especially higher vocational education, in the transformation of digital intelligence and the integration of industry and education has attracted much attention. By December 2022, 21 cities across the country had been approved as national pilot industry-education integration, and more than 4,600 enterprises had transformed into industry-education integration enterprises [1]. However, in general, there are common problems of "hot universities and cold enterprises" in the implementation process of the integration of industry and education, and the resources and operation bases of the integration of industry and education in different regions are different, which seriously hinder the systematic integration of industry and education and high-quality development. Therefore, based on the opportunity of digital and intellectual transformation, clarifying the role and path of the driving mechanism for the integration of industry and education in higher vocational education, and fully activating the participation momentum of governments, colleges, enterprises, and associations in the integration of industry and education is of great significance for promoting vocational education reform, promoting the deep integration of the four chains of education, talent, industry, and innovation, and optimizing the ecology of vocational education and economic development.

2. Literatrue Review

At present, the relevant research on the integration of industry and education focuses on the qualitative analysis level such as status quo analysis, mode innovation, integration path, operation effect and policy optimization, and the research results have been abundant. Deissinger T[2] (2022) analyzes the stability of Germany's dual system in the context of digitalization and other modern policies, and explores the institutionalized characteristics of the vocational education system and training system under the perspective of new development. Zhao Jian[3] (2021) takes the rural revitalization strategy as the research background and the high-quality development of rural vocational education as the research goal, and puts forward a system construction strategy including three dimensions: generation, governance and regulation. Wang Jin et al.[4] (2023) combed the integration mode of service major of Malaysia, and proposed to use the "five modernizations" thinking to optimize the interest conflicts of actors into the fusion point, so as to realize the translation of conflicts between stakeholders inside and outside the university, and realize the long-term operation of the mechanism. It can be seen from the literature summary that few scholars have combined the background of digital intelligence with the theoretical research on the integration of industry and education, and there is still room for fine research on the optimization of the dynamic mechanism and path of the integration of industry and education.

3. Theoretical Models and Research Hypotheses

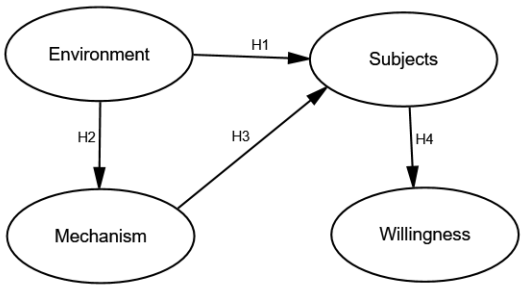

Figure 1: Study hypothesis

The integration of industry and education includes government, colleges, enterprises and industry association [5]; from the perspective of integration logic, the integration of industry and education is the embedded integration of industrial system and education system based on resources and information sharing. First of all, through the literature research and based on the research results of Liu Qing and Chen Xiaoqing[6-7] , the author summarized the dynamic sources of integration of vocational industry and education under the background of digital intelligence as three potential variables of fusion environment, fusion mechanism, fusion subjects, and fusion intention as the potential variables of internal factors. Then, referring to the results of Chen Zhenbin's analysis of the influencing factors of industry-education fusion[8], the author sorted out the action path between each variable, comprehensively considered the influence of each driving factor on the fusion intention and the interaction under the background of digital intelligence transformation, and put forward the research hypothesis (Figure 1).

H1: The fusion environment acts positively on the fusion subjects.

H2: The fusion environment acts positively on the fusion mechanism.

H3: The fusion mechanism acts positively on the fusion subjects.

H4: The fusion subjects positively act on the fusion willingness.

4. Survey Questionnaire Design and Sample Data Collection

4.1. Survey Questionnaire Design

Samsample data collection. First of all, the author summarizes the literature data of the integration mechanism of industry and education and statistics the frequency of influencing factors. The author preliminarily extracts the set of influencing factors of the integration mechanism of industry and education in higher vocational colleges under the background of digital intelligence. Then, in order to ensure the validity and reliability of the measurement model in this study, the author referred to the questionnaire results in the "Research on the influencing Factors and Evaluation System of Urban Industry and Education Integration", matched and integrated the extracted influencing factors, and designed the first draft of the questionnaire. Finally, experts were invited to improve the first draft of the questionnaire and form the final draft of the questionnaire. The questionnaire included four latent variables and 23 observed variables. All items were measured on the Likert Scale.

4.2. Survey Questionnaire Design

The questionnaire is distributed to teachers and administrators of higher vocational colleges in Shandong, Jiangsu, Guangzhou, Henan and other regions, managers of enterprises integrating industry and education, members of industry associations and staff of relevant government departments. The questionnaire star two-dimensional code tool, mainly through the teacher training WeChat group, personal relationship network, school-enterprise cooperative enterprises and other channels to locate the research objects. The questionnaire lasted 26 days, and a total of 258 questionnaires were distributed, and 246 were recovered. All answers with the same options and abnormal answer duration were excluded. Finally, 220 valid questionnaires were left, and the effective rate of the questionnaire was 89.4%.

5. Reliability and Validity Tests

According to the data processing requirements of this study and the calculation process of structural equation model, the author chose SPSSAU tool to conduct the questionnaire data reliability and validity test, and then conducted exploratory factor analysis and index dimension reduction and optimization, laying the data source foundation for the construction of structural equation model and the determination of path coefficient.

5.1. Reliability Test

The reliability test of sample data is usually characterized by Cronbach α coefficient with a range of (0, 1). The criterion is as follows: when the coefficient reaches the range of 0.7-0.8, it means that the data has considerable reliability, and when it reaches 0.8 or above, it indicates that the reliability of the scale data is very high. The calculated value of the Cronbach α coefficient of this survey questionnaire is 0.935, indicating that the data is highly reliable and meets the reliability test criteria.

5.2. Exploratory Factor Analysis

In this study, the KMO value, Bartlett spherical test and statistical significant probability Sig value were calculated to determine whether the validity test criteria of the sample data, and then determine whether it is suitable for factor analysis. The discrimination criteria are as follows: the

KMO value is> 0.6, the Bartlett spherical test value meets the multivariate normal distribution, and when the Sig value is<0.05, the structural validity of the questionnaire meets the basic requirements of factor analysis. The sample data calculation results of this study met the requirements (Table 1).

Table 1: KMO values and bartlett-test results

Number of KMO SamplingSuitability Quantities		.923
Bartlett Sphelicity Test	Approximate Chi Square	3090.890
	Free Degree	253
	Significance	.000

In this study, principal component analysis was used for factor analysis, and four principal components were extracted according to the eigenvalue and common factor gravel map, and the cumulative interpretation rate of factor was 68.032%. In addition, the correlation coefficient of the items in the same dimension. Through 5 iterations, the factor analysis model was finally optimized into 4 dimensions with 16 items (Table 2).

Table 2: Scale of influencing factors of vocational industry and education integration under the background of intelligent transformation

Latent Variable	Observable Variable
Environment	AE1 Intellectual and skilled talents have a higher salary, treatment and social status.
	AE2 The public recognizes the integration effect of industry and education.
	AE3 Continuous promotion of the application of digital intelligence technology in governments, universities, enterprises, and associations.
	AE4 Regional industrial development planning has a high matching degree with professional groups.
	AE5 There is a strong demand for the intelligent transformation and upgrading of regional industries.
Subjects	BR1 Industry associations can develop industry standards for digital intelligence.
	BR2 The regional government can regulate the conflict of interest between the subjects of industry-education integration.
	BR3 Regional governments have formulated targeted policies to boost the construction of a platform for the integration of industry and education.
	BR4 Both the school and the enterprise have the cognition of completing the transformation of digital intelligence with the integration of industry and education.
	BR5 Both schools and enterprises have the basic resources for the integration of industry and education.
Mechanism	CS1 Schools and enterprises have improved the information and resource sharing mechanism in the integration of industry and education.
Willingness	CS2 The enterprise industry associations of government colleges can obtain the expected value income in the integration of industry and education.
	CS3 The results of digital intelligence industry and education have a complete transformation mechanism.
	DH3 Recognition the integration of industry and education can enhance the competitiveness of enterprises.

6. Structural Model Fit test and Correction

According to the above constructed research hypothesis and the optimized sample data after factor analysis, in this study, AMOS 24.0 was used to draw the structural equation model, and the absolute fit and relative fit indexes were used to measure the model fitting effect. First, the degree of path fit of the research model was calculated by using the maximum likelihood estimation method, and the final path coefficient of the structural model was obtained through three rounds of correction. The results after standardization are shown in Figure 2. Then, the output results of the parameters are summarized to obtain the final fitting indicators, which are proved that all the fitting indicators meet the judgment conditions (Table 3), indicating that the structural equation model has a good fit, which can support the research hypothesis. The computational output model hypothesis validation results are shown in Table 4.

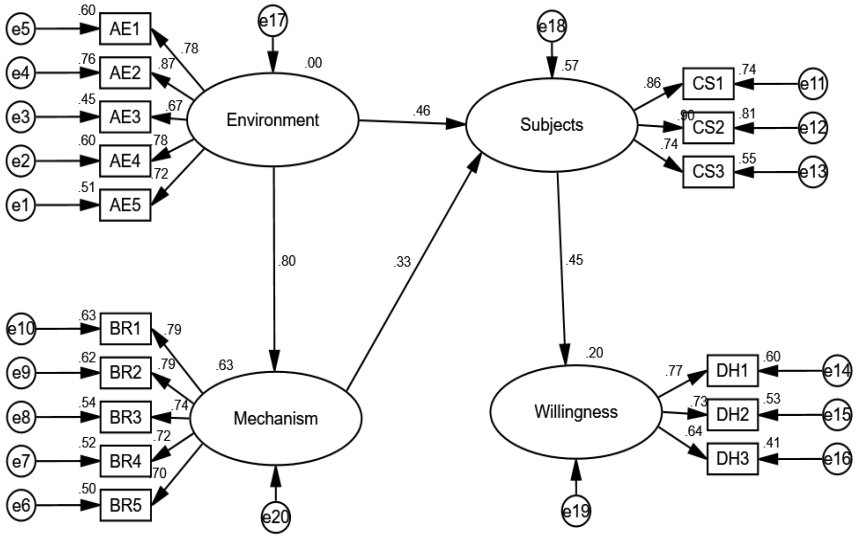

Figure 2: Structural equation model calculation results

Table 3: Model adaptation index discrimination

Indicator Type	Name of Index	Criticality Value	Output Value	Evaluation Results
Absolute Index	χ^2	Negative Indicator	182.534	Meet Requirements
	df	Positive Indicator	100	Meet Requirements
	χ^2 / df	(1,3)	1.825	Meet Requirements
	GFI	＞0.9	0.913	Meet Requirements
	AGFI	＞0.9	0.882	Acceptable
	RMR	<0.05	0.025	Meet Requirements
	RMSEA	<0.08	0.061	Meet Requirements
Relative Indices	NFI	＞0.9	0.909	Meet Requirements
	CFI	＞0.9	0.956	Meet Requirements
	TLI	＞0.9	0.947	Meet Requirements

Table 4: Standardized path coefficients and validation results of the revised research hypothesis model

Independent Variables	Dependent Variables	Std.	SE	CR	P-value	Hypothesis	Conclusion
Environment	Mechanism	0.795	0.088	8.302	***	H2	Supportive
Environment	Subjects	0.465	0.161	4.041	***	H1	Supportive
Mechanism	Subjects	0.333	0.174	2.931	**	H3	Supportive
Subjects	Willingness	0.452	0.044	5.695	***	H4	Supportive

Note: * Represents a P- value < 0.05; * * Represents a P- value < 0.01; * * Represents a P- value < 0.001

7. Model Analysis and Optimization Countermeasures

7.1. Model Analysis

From the standardized path coefficient analysis among potential variables in Figure 2, it can be seen that the correlation between variables is very significant, indicating that in the process of constructing the dynamic mechanism of industry-education integration behavior, the utility of potential variables is comprehensive and linked, and they are all key factors, but the impact degree of each variable is slightly different. The total index of the impact of the fusion environment on the fusion subjects is: 0.46+0.8×0.33=0.724, significant effect; the total index of the impact of the integration mechanism on the integration subjects is 0.33, which mainly plays a mediating role and indirectly affects the willingness to integrate. The impact index of fusion subjects on fusion intention is 0.45, which significantly affects fusion intention. From the factor load and SMC of each item in Figure 2, it can be seen that each observation variable has a significant impact on potential variables, and the effect of each observation variable is equivalent.

7.2. Optimization Countermeasures

7.2.1. People oriented, improve integrated environmental policies, and build a digital, intelligent, collaborative innovation platform for governments, universities, enterprises, and associations.

Take the government as the leading factor, improve the system supply, rely on technologies such as 5G, artificial intelligence, and big data to build innovative platform carriers with functions such as sharing, co construction, and co governance, accurately match the resources and information needs of participating entities, and enhance the integration "stickiness" of the four participating entities.

7.2.2. Ensure the sustainability of integration dynamics within the framework of digital intelligence by reconstructing the collaborative development niche of four parties and improving the operational mechanism.

Taking the realization of project objectives as a system value consensus, we can choose to use the PPP project operation framework to optimize resource allocation, while introducing digital and intelligent technologies and concepts as the driving force for transformation and innovation of higher vocational colleges and enterprises. Finally, we can promote the seamless integration of regional industries and education systems through the "point-line-surface-network-three-dimensional" approach, attracting enterprises to independently participate in the industry-education

integration system. Relying on the ecological positioning and operational advantages of various entities, we will improve the mechanisms of mutual benefit and symbiosis, dynamic balance, information flow, and evaluation and feedback, ensuring the continuous supply of integration power and long-term stability.

7.2.3. Do a good job in piloting the digital and intelligent transformation of various types of industrial and educational integration at all levels, and comprehensively promote the iterative evolution of vocational education and industrial digital and intelligent transformation from point to area.

Actively explore the digital and intellectual transformation ideas and paradigms of diversified industrial and educational integration pilot projects, build provincial and urban level integration pilot projects, summarize operational experience, and play a radiation and promotion role. In addition, we will improve the standardization of the integration process of digital, intellectual, industrial, and educational integration, broaden the functional attributes of vocational education, and rely on digital, intellectual, and technological platforms to promote the integration and aggregation of educational resources and industrial data, achieving the platform-based popularization and sharing of high-quality resources.

8. Conclusions

In the era of digital intelligence transformation, vocational education and industrial development are both facing the transformation and reshaping of digital intelligence. Vocational education, especially higher vocational education, has complex and specific characteristics. On the one hand, it needs to achieve its own transformation and connotative development through the integration of industry and education, and on the other hand, it needs to contribute to the new development pattern of industrial iteration. As an effective development model to promote the organic integration of the education system and the industrial system, in the context of digital and intellectual transformation, the integration of industry and education should coordinate the three system dimensions of environment, mechanism, and main body, and address communication barriers between governments, universities, enterprises, and industry associations from a platform perspective; At the same time, coordinate the risks and benefits among various entities, and create a digital, intelligent, industrial, and educational integration platform with a systematic thinking perspective; In addition, "earned value method", PDCA cycle, and other methods can be integrated into the process of building dynamic mechanisms and ecological balance, to achieve win-win results and stable mechanisms under the digital, intelligent, industrial, and educational integration system.

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