Development Model of Higher Education Cluster in Chengdu and Chongqing

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Abstract

This study endeavors to investigate the influencing factors behind the development of higher education clusters in the Chengdu-Chongqing region and establish a model aimed at enhancing their effectiveness. To achieve this objective, a Likert Scale was employed, comprising four primary dimensions, 14 secondary dimensions, and 39 items, initially validated through a pre-survey and SPSS software analysis. Subsequently, 405 valid questionnaires were collected from government officials, university administrators, and business leaders in the Chengdu-Chongqing region through an online platform and email. SmartPLS software was then used for analysis, confirming strong reliability and discriminant validity of the survey data. Further structural analysis revealed no issues of collinearity and identified government, universities, and enterprises as positively influencing factors on the Chengdu-Chongqing higher education cluster's effectiveness. Eight secondary dimensions and 17 items were identified as positively impacting cluster effectiveness, leading to the formulation of a government-university-enterprise model for higher education cluster development in the Chengdu-Chongqing region.

Keywords: Higher Education Cluster, Chengdu-Chongqing Region Development Model, Influencing Factors, Effectiveness Enhancement.

Introduction

China's Chengdu-Chongqing region, as shown in Figure 1, boasts a strategic geographical location, economic complementarity, and efficient transportation networks, housing a population of approximately 116 million alongside 208 colleges and universities, as detailed in the table. It has emerged as a prominent hub for science and education in Western China (Zhu & Yang, 2023). Higher education's pivotal role in societal advancement cannot be overstated. It not only imparts knowledge and expertise but also nurtures individuals with strong moral and physical attributes, effectively contributing to the socio-economic development of nations and ethnic groups (Tri et al., 2021). Achieving this necessitates close and efficient collaboration among governments, higher education institutions, future professionals, employers, and innovative clusters (Lysenko et al., 2020). Given the profound social significance of higher education in sustainable societal development and the contemporary challenges faced by the education, science, and production sectors, transitioning to a cluster development model for continuous pedagogical education has become imperative (Khodjamkulov, 2020). The globalizing landscape calls for clustering not only in education but across various domains, as globalization intensifies competition in the education services market, wherein clusters offer a means to counteract its effects (Mukhamedov et al., 2020).

Higher education, as a critical investment in human capital, is increasingly central to promoting high-quality economic development (Ji et al., 2023). Strategies aimed at sustaining national economic growth underscore the vital need for training highly skilled personnel within the cluster infrastructure of higher education institutions (Khramtsova, 2020). The emergence of higher education clusters has become a pivotal phenomenon in global regional development strategies (De Wit & Altbach, 2021). Examples from around the world illustrate this trend: the San Francisco Bay Area effectively integrates leading universities and advanced high-tech enterprises, creating a synergistic center that seamlessly integrates production, education, research, and political engagement (Tsuruta, 2019). The Tokyo Bay Area is home to a super international university higher education cluster, part of the Japanese government's 2014 plan to enhance the internationalization of Japanese universities and society (Deng, 2022). Likewise, the development of higher education in the Guangdong-

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Hong Kong-Macao Greater Bay Area has strengthened partnerships, evolving from cooperation to strategic coordination and resource sharing (Wang & Liu, 2023). Notably, universities like Stanford University and the University of California, Berkeley, in the San Francisco Bay Area actively engage in the business ecosystem, collaborating with government and industry to generate employment opportunities and foster long-term sustainable development (Piqu E et al., 2020). Elevating the tripartite relationship among universities, enterprises, and governments promises to yield significant benefits for regional development (Xie et al., 2023).
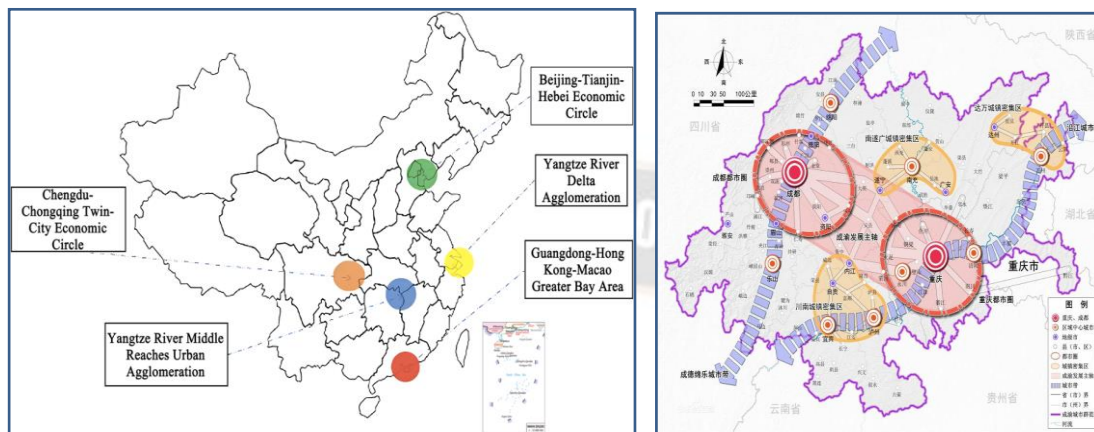

Figure 1. Location Map of the Chengdu-Chongqing Region, China

Table 1. Basic Information on Colleges and Universities in the Chengdu-Chongqing Region

	Public University	Private University	Add up
Undergraduate	53	27	80
Specialty	71	57	128
First-class universities in	21	0	21

Literature Review

Cluster theory underscores the advantages of geographic concentration among related industries, institutions, and supporting organizations (Porter, 1998). In the context of higher education clusters, the focus shifts to the benefits of co-locating universities, research institutions, and industry partners to facilitate collaboration, knowledge exchange, and innovation (Sánchez-Barrioluengo et al., 2019). The triple helix model emphasizes the importance of linkages and collaboration among academia, industry, and government (Leydesdorff & Etzkowitz, 1996). Prominently advanced countries often exhibit top-tier institutions of higher learning and world-class university clusters, such as the Ivy League in the United States, the Russell Group in the United Kingdom, the Union of German Polytechnic Universities (TU9), and Australia's Group of Eight (Go8) (Song, 2018). University clusters are characterized by collaborative innovation, resource sharing, competition, and cooperation (Tao & Shuliang, 2022). The key objectives of regional higher education cooperation and development encompass innovating cooperation mechanisms, enhancing the higher education system, harnessing synergistic effects, cultivating core competitiveness, mitigating the "island effect," and elevating educational standards (Xue & Li, 2021). University cooperation in China is guided by mechanisms involving government guidance, partner selection, standardized operations, innovation and development encouragement, venture capital evaluation, and benefit distribution (Meng et al., 2022). University cluster models in locations like New York, San Francisco, and Tokyo encompass multi-center + axis, multi-center complementary clusters, and center + border configurations (Liao & Meng, 2020). The development of higher education in the Greater Bay Area has advanced partnership dynamics, evolving from cooperation to strategic coordination and resource sharing (Xie et al., 2023). Universities serve as producers of various products, including educational services, scientific and technical outputs, and educational and methodological guides (Shavkatovna & Batirovna, 2023).

Methods

This study employs a combination of focus groups and questionnaires to investigate the role of government, universities, and enterprises in the development of higher education clusters in the Chengdu-Chongqing region. It seeks to understand the influencing factors and assess cluster

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effectiveness. The research adopts a mixed-methods approach, integrating qualitative and quantitative research techniques, with data analysis and structural modeling conducted using SPSS 23.0 and SmartPLS 4.0. The study engages nine experts in three rounds of data collection to ensure comprehensive insights.

Focus Group

Round 1: Semi-Structured Interviews

In the initial round, a focus group consisting of nine participants, including government officials, university administrators, and business leaders, conducted semi-structured interviews via video conferencing. The researcher moderated the discussions, guiding the experts to explore the factors influencing the development of higher education clusters in the Chengdu-Chongqing region. The focus centered on the roles played by government, universities, and enterprises. A total of 37 factors and 16 effectiveness indicators emerged from this round, forming the basis for a questionnaire.

Round 2: Expert Opinion Evaluation

In the second round, the experts reviewed the structure, content, and wording of the initial questionnaire, providing feedback on its refinement, accuracy, sequence,

and logical flow. Researchers then refined and streamlined relevant statements. As a result, the questionnaire was modified to include four first-level indicators and ten second-level indicators for government influencing factors, four first-level indicators and 12 second-level indicators for university influencing factors, two first-level indicators and five second-level indexes for enterprise influencing factors, and four first-level indicators and 12 second-level indexes for assessing the effectiveness of the Chengdu-Chongqing higher education cluster. This revised questionnaire formed the basis for the subsequent rounds of data collection.

Round 3: Reassessment

In the third round, the nine experts re-evaluated the modified questionnaire, ensuring its alignment with the study's objectives and research goals.

Questionnaire Survey

The final questionnaire, derived from the third round, was converted into a Likert scale. A pre-survey was conducted to refine the questionnaire further, followed by the formal data collection phase. To facilitate data processing, analysis, and structural modeling, the researchers assigned codes to both the first and second dimensions of the questionnaire (as detailed in Table 2).

Table 2. Symbols Used to Represent Each Index Item

Primary and secondary dimension	Substitute Symbol
Government Factors：Policy Support,	PS;PS1;PS2;PS3
Government Factors：Infrastructure Support	IS;IS1;IS2
Government Factors：Financial Support	FS;FS1;FS2;FS3
Government Factors：Research Project Support	RPS;RPS1;RPS2
University Factors：Interdisciplinary Research Program	IRP;IRP1;IRP2;IRP3;IRP4;IRP5
University Factors：Joint Talent Cultivation	JTC;JTC1;JTC2;JTC3
University Factors：Science Promotion Programs	SPP;SPP1;SPP2
University Factors：International Cooperation and Exchange	ICE;ICE1;ICE2;
Enterprise Factors：Industry-Academia-Research Collaboration	IARC;IARC1;IARC2;IARC3
Enterprise Factors：School-Enterprise Collaboration	SFC;SFC1SFC2
Higher Education Cluster Development Results：Talent Cultivation	TC;TC1;TC2;TC3
Higher Education Cluster Development Results：Resource Sharing	RS;RS1;RS2;RS3
Higher Education Cluster Development Results：Scientific Research	SR;SR1;SR2;SR3;SR4
Higher Education Cluster Development Results：International Exchange and Cooperation	IEC;IEC1;IEC2

Research Results

The focus group, conducted over three rounds, identified that the government, universities, and enterprises are the key factors influencing the development of the higher education cluster in the Chengdu-Chongqing region.

Additionally, it recognized that factors such as personnel training, resource sharing, science and education, and international exchanges play crucial roles in determining the effectiveness of higher education cluster development.
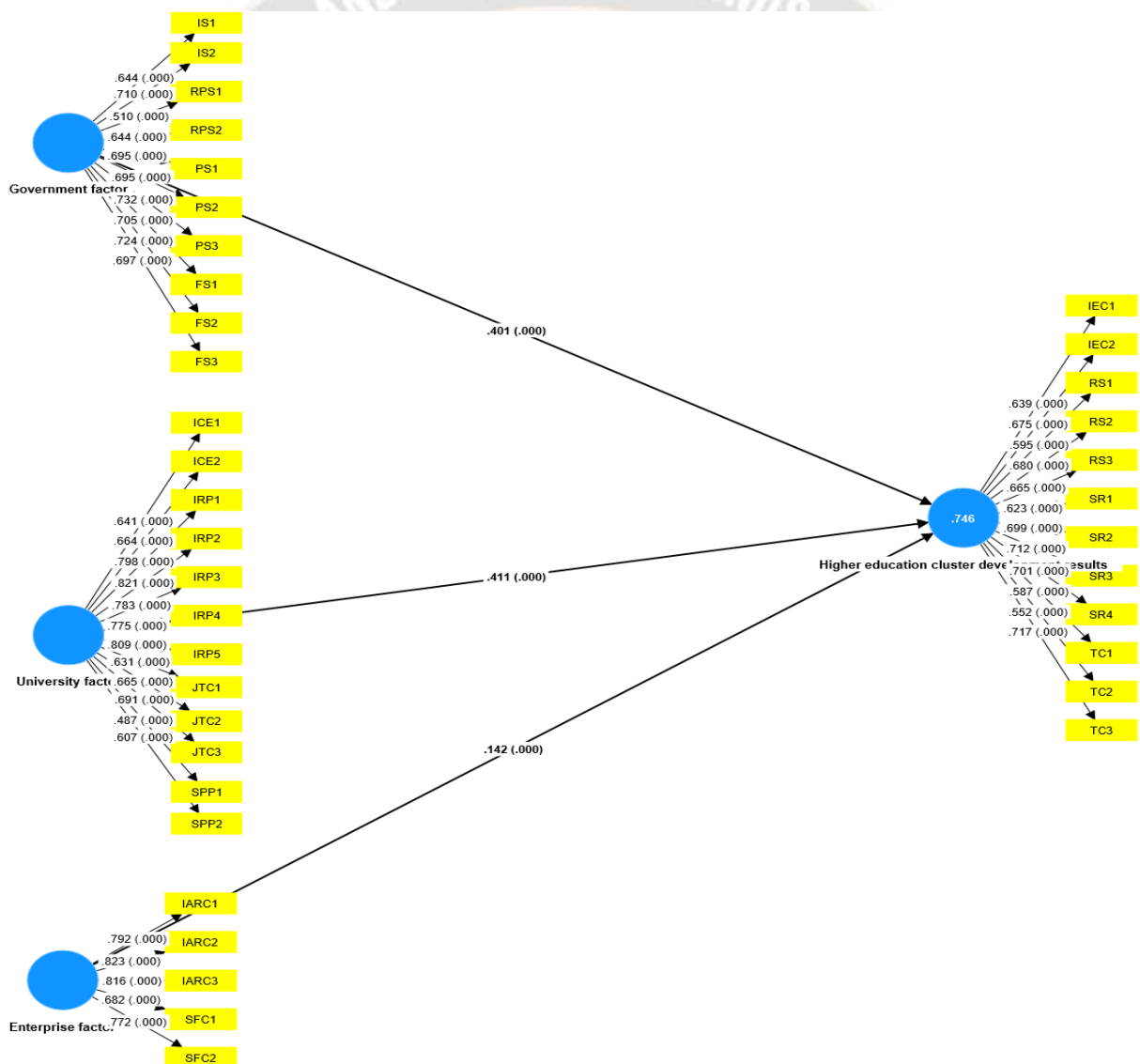
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Table 3. Level 1 Indicator Path Analysis Results

	Original Sample	Sample Mean	Standard Deviation	T-Statistic	P-Value
Enterprise factor -> Higher education cluster development	0.142	0.142	0.038	3.745	0.000
Government factor -> Higher education cluster	0.401	0.401	0.044	9.133	0.000
University factor -> Higher education cluster development	0.411	0.411	0.038	10.88	0.000

As observed in Table 3, the path coefficients for the Enterprise factor, Government factor, and University factor, with respect to the development outcomes of the higher education cluster in the Chengdu-Chongqing region, are 0.142, 0.401, and 0.411, respectively, all of which demonstrate significant influence with $p < 0.001$. These findings affirm the substantial impact and significance of the Enterprise, Government, and University factors on the development outcomes of the higher education cluster, as illustrated in its structural model depicted in Figure 1.
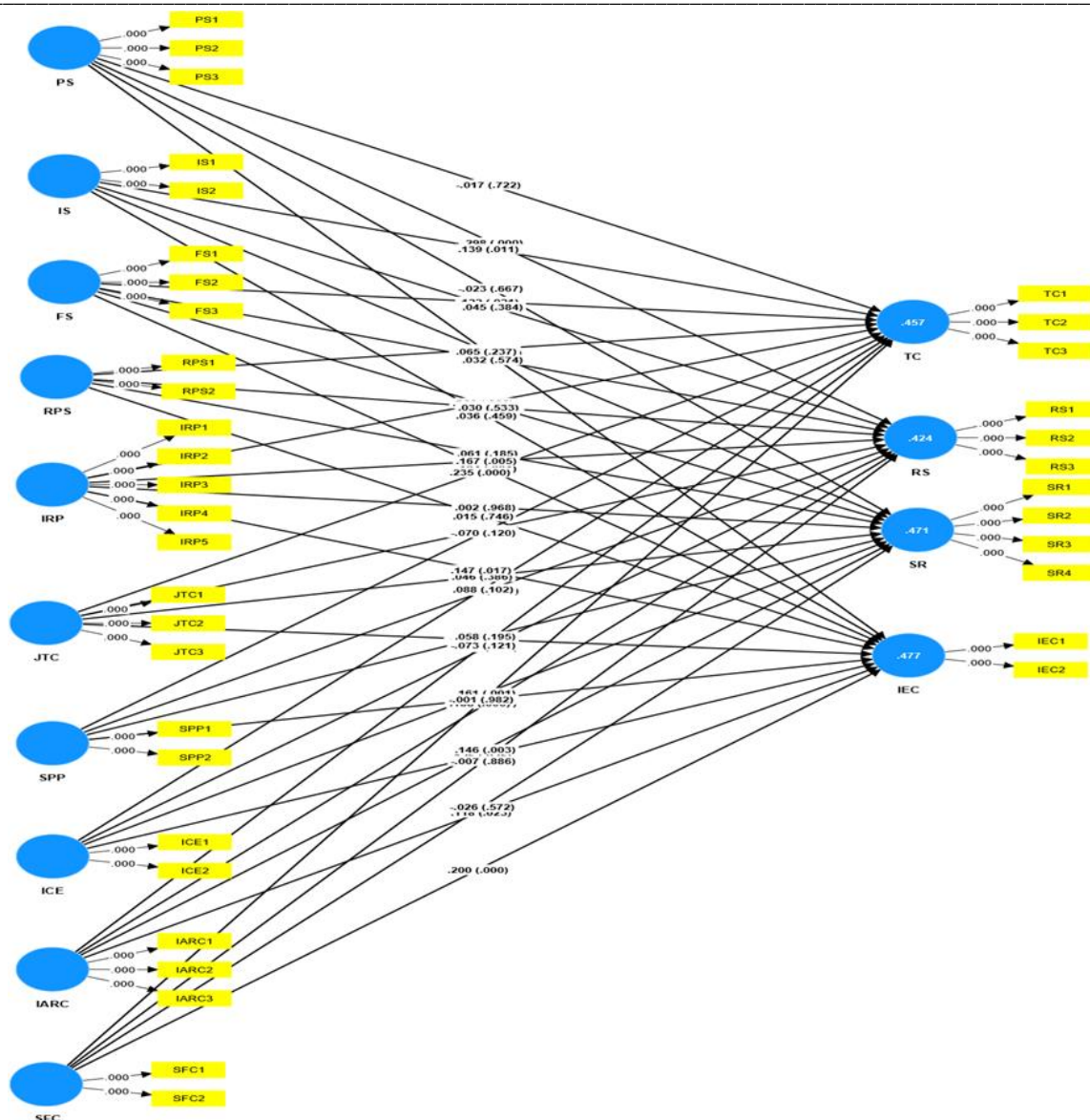

Figure 2. Level 1 Index Model

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Table 4. Secondary Indicator Path Analysis Results

	Original Sample	Sample Mean	Standard Deviation	T Statistic	P Value	Significant
Industry-Academia-Research Collaboration -> Cluster higher education International Cooperation and	0.118	0.119	0.052	2.282	0.023	▲
Industry-Academia-Research Collaboration -> Scientific Research on Cluster Higher Education	0.146	0.147	0.049	2.995	0.003	▲
Industry-Academia-Research Collaboration -> Scientific Research on Cluster Higher Education	-0.073	-0.073	0.047	1.553	0.121	
Industry-Academia-Research Collaboration -> Cluster High Education Resource Sharing	0.064	0.062	0.054	1.18	0.238	
International Cooperation and Exchange -> Cluster higher education International Cooperation and	0.126	0.127	0.056	2.244	0.025	▲
International Cooperation and Exchange -> Scientific Research on Cluster Higher Education	0.161	0.162	0.05	3.204	0.001	▲
International Cooperation and Exchange -> Scientific Research on Cluster Higher Education	0.088	0.089	0.054	1.637	0.102	
International Cooperation and Exchange -> Cluster High Education Resource Sharing	0.056	0.055	0.056	1.001	0.317	
Infrastructure Support -> Cluster higher education International Cooperation and Exchange	0.036	0.034	0.049	0.74	0.459	
Infrastructure Support -> Scientific Research on Cluster Higher Education	0.356	0.356	0.045	7.91	0.000	▲
Infrastructure Support -> Scientific Research on Cluster Higher Education	0.139	0.139	0.055	2.553	0.011	▲
Infrastructure Support -> Cluster High Education Resource Sharing	0.045	0.046	0.052	0.87	0.384	
Interdisciplinary Research Program -> Cluster Higher Education International Cooperation and Exchange	0.147	0.147	0.062	2.377	0.017	▲
Interdisciplinary Research Program -> Scientific Research on Cluster Higher Education	0.002	0.001	0.056	0.04	0.968	
Interdisciplinary Research Program -> Scientific Research on Cluster Higher Education	0.26	0.259	0.053	4.932	0.000	▲
Interdisciplinary Research Program -> Cluster High Education Resource Sharing	0.167	0.168	0.06	2.789	0.005	▲
Research Project Support -> Cluster Higher Education International Cooperation and Exchange	0.015	0.017	0.047	0.323	0.746	
Research Project Support -> Scientific Research on Cluster Higher Education	0.061	0.061	0.046	1.326	0.185	
Research Project Support -> Scientific Research on Cluster Higher Education	-0.03	-0.03	0.05	0.595	0.552	
Research Project Support -> Cluster High Education Resource Sharing	0.03	0.03	0.048	0.624	0.533	
Joint Talent Cultivation -> Cluster higher education International Cooperation and Exchange	0.05	0.05	0.049	1.029	0.304	
Joint Talent Cultivation -> Scientific Research on Cluster Higher Education	0.046	0.045	0.053	0.867	0.386	
Joint Talent Cultivation -> Scientific Research on Cluster Higher Education	0.235	0.234	0.046	5.082	0.000	▲
Joint Talent Cultivation -> Cluster High Education Resource Sharing	0.212	0.213	0.052	4.069	0.000	▲
Science Promotion Programs -> Cluster Higher Education International Cooperation and Exchange	-0.001	-0.002	0.05	0.023	0.982	
Science Promotion Programs -> Scientific Research on Cluster Higher Education	0.058	0.06	0.045	1.297	0.195	
Science Promotion Programs -> Scientific Research on Cluster Higher Education	-0.07	-0.072	0.045	1.555	0.120	

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	Original Sample	Sample Mean	Standard Deviation	T Statistic	P Value	Significant
Science Promotion Programs -> Cluster High Education Resource Sharing	-0.046	-0.048	0.047	0.978	0.328	
School-Enterprise Collaboration -> Cluster higher education International Cooperation and Exchange	0.2	0.199	0.052	3.821	0.000	▲
School-Enterprise Collaboration -> Scientific Research on Cluster Higher Education	-0.026	-0.026	0.046	0.565	0.572	
School-Enterprise Collaboration -> Scientific Research on Cluster Higher Education	0.188	0.189	0.053	3.509	0.000	▲
School-Enterprise Collaboration -> Cluster High Education Resource Sharing	-0.007	-0.007	0.05	0.143	0.886	
Policy Support -> Cluster higher education International Cooperation and Exchange	0.065	0.065	0.055	1.182	0.237	
Policy Support -> Scientific Research on Cluster Higher Education	-0.023	-0.024	0.054	0.431	0.667	
Policy Support -> Scientific Research on Cluster Higher Education	-0.017	-0.017	0.049	0.356	0.722	
Policy Support -> Cluster High Education Resource Sharing	0.298	0.3	0.05	5.979	0.000	▲
Financial Support -> Cluster higher education International Cooperation and Exchange	0.194	0.193	0.06	3.239	0.001	▲
Financial Support -> Scientific Research on Cluster Higher Education	0.146	0.145	0.053	2.77	0.006	▲
Financial Support -> Scientific Research on Cluster Higher Education	0.122	0.124	0.053	2.309	0.021	▲
Financial Support -> Cluster High Education Resource Sharing	0.032	0.031	0.057	0.562	0.574	

Table 4 reveals significant impact pathways. Specifically, government factors such as policy support, infrastructure support, and financial support have a notable influence on the development of higher trade clusters in the Chengdu-Chongqing region. Likewise, university factors, including interdisciplinary research plans, joint talent training, and international exchange and cooperation, exhibit significant effects on the development of higher trade clusters in the Chengdu-Chongqing region. Additionally, the collaboration between industry, universities, and research institutes, as well as the co-establishment of educational institutions and enterprise factors, notably affect the development of higher trade clusters in the Chengdu-Chongqing region, as illustrated in the structural model presented in Figure 3.
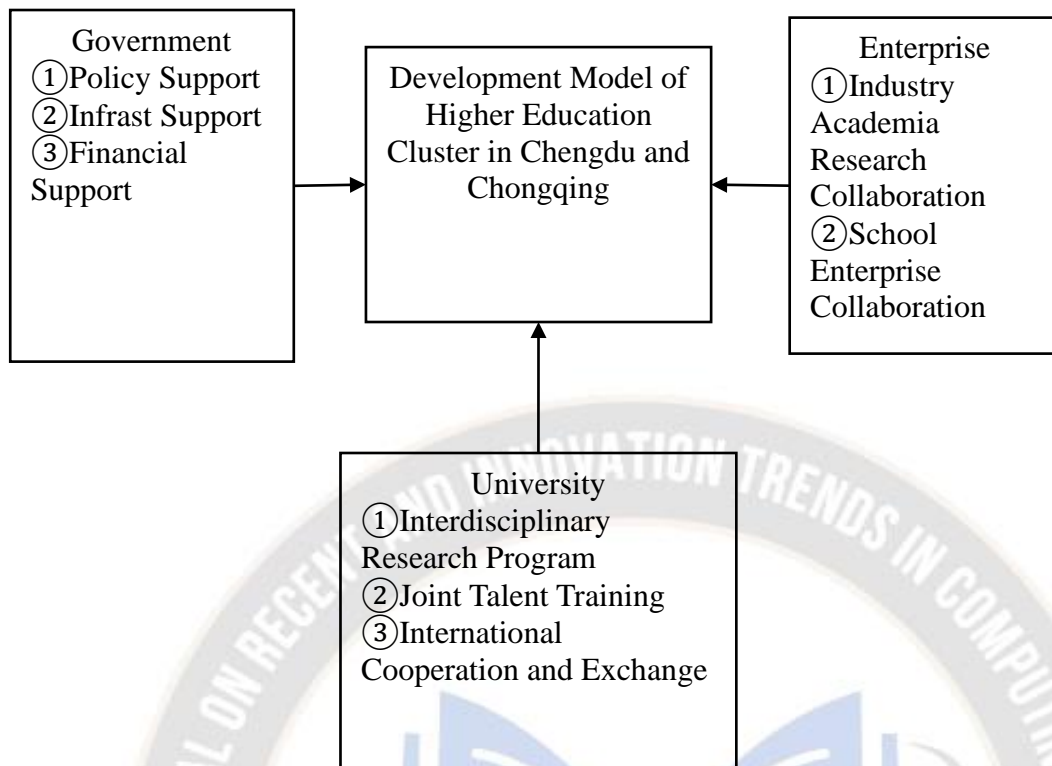
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Figure 3. Two-Level Index Model

In accordance with the first and second index models, the government-university-enterprise model for the development of higher education clusters in the Chengdu-Chongqing region is established, as depicted in Figure 4.

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Figure 4. GUE Model of Higher Education Cluster Development in Chengdu and Chongqing

The government, universities, and enterprises guide the development of higher education clusters in the Chengdu-Chongqing region. The Government-University-Enterprise (GUE) model underscores the significance of collaboration and interaction among these stakeholders, fostering synergy to propel the development of higher education clusters in the Chengdu-Chongqing region.

Conclusion and Recommendation

This study utilizes the focus group method, conducting in-depth interviews to delve into the critical factors and effects influencing the development of higher education clusters in the Chengdu-Chongqing region. It focuses on four key dimensions within the three primary elements of government, universities, and enterprises. Simultaneously, extensive quantitative data is gathered through a questionnaire survey, and research hypotheses are rigorously confirmed through meticulous data analysis.

The practical implications of the Government-University-Enterprise (GUE) model are highly positive. By fostering collaborative relationships among the government, universities, and enterprises, the model effectively enhances the quality of personnel training in universities, facilitates resource sharing, elevates the level of scientific research, and deepens international exchanges. Implementing this model enables universities to align more effectively with industry needs, fostering innovative responses to market demands. Additionally, the promotion of the GUE model has a favorable impact on regional innovation and development, furthering regional economic growth and sustainable progress.

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