An Analysis of Research Hot Points of Industry-Education Integration Based on Keywords Co-occurrence Clustering

Ping Li [a,*], Jincheng Xu[b] and Jing Li[c]

Office of Academic Research, Beijing Information Technology College, Beijing, China

[a]Liping-n@bitc.edu.cn,[b]Xujc@bitc.edu.cn,[c]Lijing@bitc.edu.cn

*corresponding author

Keywords: Industry-education Integration; Co-occurrence Clustering Analysis; Research Hot points

Abstract: In order to explore the research status and development trends of the integration of industry and education, statistical analysis was carried out on 847 literature related to industry-education integration research in the full-text database of CNKI from 2014 to 2019, including SCI source journals, EI source journals, core journals, CSSCI, CSCD, and the database of doctoral dissertations, by the keywords co-occurrence clustering analysis method, the BICOMB2 bibliographic co-occurrence analysis system and the SPSS22 data statistical software. The results showed that the current research on the integration of industry and education in China mainly focused on the field of education, and the research hot points present four dimensions: the national development strategy, the transformation of local universities, the reform of vocational education, and the construction of industrial colleges. In the future, 'the enterprise construction of industry and education integration' may become a new research hot points, which will lead to extensive and in-depth research on the issue of industry and education integration.

1. Introduction

As one of the important contents of the national development strategy, the industry-education integration has become the focus of deepening the reform and connotation development of vocational education. In recent years, the research about it has developed rapidly and achieved fruitful results. At this stage, it is necessary to comb and analyze the research results of the integration between industry and education, present the research status and development trends in time, and provide some references for scholars to further focus on the hot issues and frontier issues of industry-education integration.

2. Research Design

Keywords Co-word analysis. Through statistics of the frequency of keywords in the literature and hierarchical clustering, the structural changes of these words are analyzed to determine the research hot points in a certain field.

In order to focus on the fusion of research in the field of production and education authority and frontier, 1177 literature records were found, using the industry-education integration as a keyword, by searching the Chinese full text database of SCI source journals, EI source journals, core journals, CSSCI, CSCD, and dissertations database from January 1, 2014 to December 31, 2019. After excluding non-research documents such as contributions wanted, school introductions, profiles, and conference reports, 847 effective documents were obtained, including 822 journal papers and 25 dissertations, which were downloaded and saved in NoteFirst format for subsequent data processing and statistical analysis.

The BICOMB2 bibliographic co-occurrence analysis system and SPSS22 data statistics software were the main research tools. First, the BICOMB2 bibliographic co-occurrence analysis software was used to extract and count 847 exported and downloaded NoteFirst data, and generate lexicon matrix and co-occurrence matrix. Then, SPSS22 data statistics software was used to perform cluster

analysis on the lexicon matrix and co-occurrence matrix generated by BICOMB2.

3. Keywords Co-occurrence Cluster Analysis

3.1. High-frequency Keywords Extraction

By using the BICOMB2 bibliographic co-occurrence analysis system to extract keywords from 847 records, 4128 keywords were obtained. Afterwards, these keywords were optimized. On the one hand, it removed valueless keywords. On the other hand, it combined keywords with the same meaning but different expressions. After optimization, 3877 keywords were obtained. On this basis, the frequency threshold was set to '≧10', and the keyword research object of 'industry-education integration' was removed, and the top 28 high-frequency keywords (as shown in Table 1) were selected to generate the text matrix and co-occurrence matrix to prepare for subsequent statistical analysis.

Table 1. High-frequency Keywords

No.	Key Words	Frequency	Percentage	Cumulative Percentage
1	Vocational Education	240	6.95	6.95
2	School-enterprise Cooperation	173	5.01	11.96
3	Vocational Colleges	134	3.88	15.85
4	Higher Vocational Education	103	2.98	18.83
5	Personnel Training Mode	82	2.38	21.21
6	Modern Vocational Education System	75	2.17	23.38
7	Application-oriented Universities	57	1.65	25.03
8	Enterprises	42	1.22	26.25
9	Vocational Colleges	41	1.19	27.43
10	Innovation and Entrepreneurship	34	0.98	28.42
11	Modern Apprenticeship System	33	0.96	29.37
12	Specialty Construction	33	0.96	30.33
13	Schools	33	0.96	31.29
14	Local Colleges and Universities	32	0.93	32.21
15	Transformation Development	28	0.81	33.02
16	Ministry of Education	24	0.70	33.72
17	Vocational Education Group	22	0.64	34.36
18	Applied Talents	20	0.58	34.94
19	Supply-side Reform	18	0.52	35.46
20	Educational Administrative Organization	18	0.52	35.98
21	Path	17	0.49	36.47
22	Cooperative Education	16	0.46	36.94
23	Craftsmanship Spirit	15	0.43	37.37
24	One Belt and One Road	13	0.38	37.75
25	National Vocational College Skills Competition	13	0.38	38.12
26	Engineering Institute	12	0.35	38.47
27	Made in China 2025	11	0.32	38.79
28	Secondary Vocational Schools	10	0.29	39.08
Total		1349	——	——

As can be seen from Table 1, the total frequency of 28 high-frequency keywords was 1,349, accounting for 39.08% of the total frequency of keywords after data optimization, which largely reflected the research hot points in the field of industry and education integration since 2014.

3.2. High-frequency Keyword Similarity Matrix

In the matrix page of BICOMB2 bibliographic co-occurrence analysis system, frequency thresholds were set as '≥10' and '≤240', and 28 high-frequency keywords as shown in Table 1 were matrix processed to generate and export the lexical matrix in the format of '.txt'. After that, the lexicon matrix was imported into SPSS22 data statistics software for distance correlation analysis of

Ochiai coefficient of dichotomy, and the lexicon matrix was transformed into a 28×28 co-word similarity matrix to prepare for clustering analysis, as shown in Table 2.

Table 2. Similarity matrix of high-frequency keywords two-class Ochiai coefficients (partial)

	1:Vocational Education	2:School-enterprise Cooperation	3: Higher Vocational Colleges
1: Vocational Education	1.000	0.319	0.080
2: School-enterprise Cooperation	0.319	1.000	0.132
3: Vocational Colleges	0.080	0.132	1.000
4: Higher Vocational Education	0.074	0.134	0.130
5: Personnel Training Mode	0.113	0.101	0.071

3.3. High-frequency Keyword Clustering Analysis

Cluster analysis was carried out by means of inter-group connection and square Euclidean distance method, and the cluster pedigree diagram was generated, as shown in Figure 1. Since 2014, China's research hot points in the field of industry-education integration have mainly presented four dimensions: national development strategy, transformation of local universities, vocational education reform, and industrial college construction. The high-frequency keyword clustering results are shown in Table 3.

Table 3. High-frequency Keywords Clustering Results in Four Research Dimensions

Research Dimensions	High-frequency Keywords
National development strategy	Ministry of Education, educational administration organization, One Belt and One Road
Transformation of local universities	Local universities, transformation and development, applied undergraduates, applied talents
Vocational education reform	Higher vocational colleges, innovation and entrepreneurship, personnel training model, specialty construction Secondary vocational schools, craftsmanship spirit, National Vocational College Skills Competition Modern vocational education system, vocational colleges, vocational education, school-enterprise cooperation, enterprises, schools Vocational education group, modern apprenticeship system, higher vocational education
Industrial college construction	Industrial colleges, collaborative education, Made in China 2025, Supply-side reform, path

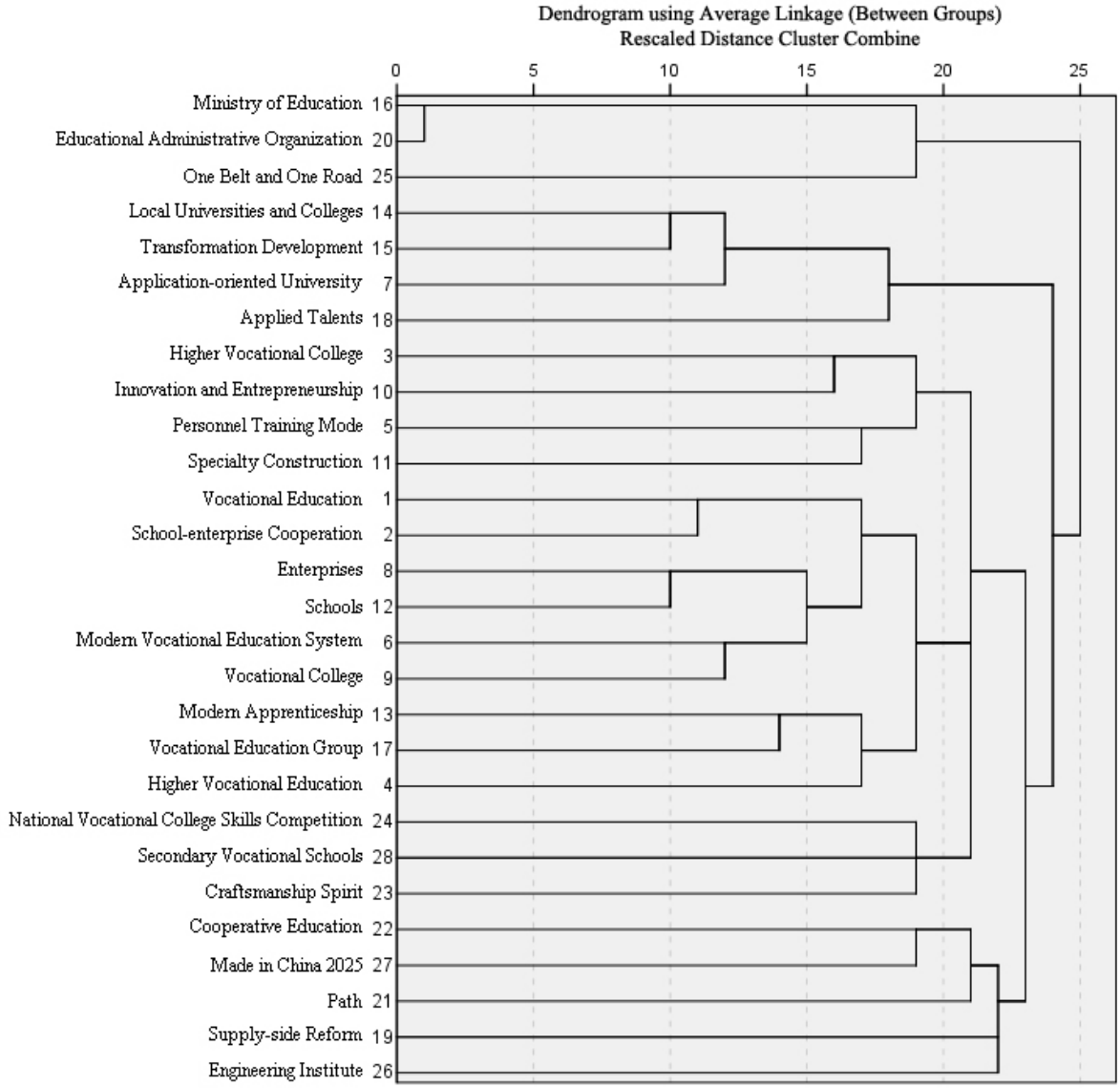

Figure 1. High-frequency keyword clustering pedigree diagram

3.3.1. From the Dimension of National Development Strategy

From the perspective of national development strategy, the integration of industry and education is 'go global' under the background of 'The Belt and Road Initiative'. At the school level, vocational colleges and universities, with the help of 'One Belt and One Road' Initiative, should build an international cooperation network of 'schools + enterprises' for industry-education integration and innovation, to promote the participation of vocational education and higher education in cooperation with 'The Belt and Road Initiative' construction and international production capacity cooperation, to provide talent support and guarantee for Chinese enterprises to 'go global' [1]. Specific ways are as follows: School-enterprise cooperation with overseas schools provides vocational training and academic education for employees of Chinese-funded enterprises and local people [2]; 'National Vocational Skills Competition' docking 'World Skills Competition' to promote the internationalization of vocational skills talents training; Luban Workshop exports Tianjin's excellent vocational and technical education and teaching results in the form of academic education and vocational training, serving international production capacity cooperation and Chinese enterprises 'going global' of 'One Belt and One Road' [3], etc.As to enterprises, in-depth research should be conducted on the integration of production and education and the development path of enterprise internationalization under the background of 'One Belt and One Road' Initiative, as well as the reform and innovation of enterprise human resource management [4].

3.3.2. From the Dimension of Local Universities and Colleges Transformation

From the perspective of the transformation of local universities and colleges, the industry-education integration is the 'four transformations', carried out by some local ordinary universities and colleges to adapt to the new normal of economic development. From the perspective of research content, some scholars conducted empirical researched on the industry-education integration of 11 public application-oriented undergraduate universities in Fujian Province, and found that application-oriented undergraduate universities are facing difficulties such as lack of close industrial connection, obstacles in school management mechanism, low enthusiasm of enterprises, and insufficient support of national policies, thus they proposed countermeasures [5]. Some scholars put forward that application-oriented universities should properly handle the relationship between industrial demand and discipline development in terms of talent training. They should not ignore the actual needs of the society, let alone the cultivation of students' basic theoretical basis and innovation ability, as well as the necessary supporting role of scientific research [6]. Some scholars have divided the industry-education integration model into four types: industry-education integration research and development model, industry-education integration co-construction model, project traction model, and personnel training and communication model [7]. Some scholars proposed to build a 'trinity' of work think tanks, battle think tanks and social think tanks to provide all-round guidance and consulting services for the transformation and development of universities and the deep integration of industry and education [8].

3.3.3. From the Dimension of Vocational Education Reform

From the perspective of vocational education reform, the amalgamation of industry and education is a leap in vocational education's re-understanding of school-enterprise cooperative school-running mode. The industry-education integration aims to solve the matching problem between school-running mode and economic mode from the perspective of economy, while school-enterprise cooperation aims to solve the matching problem between personnel training mode and talent working mode from the perspective of education. They are two different levels of thinking logic [9]. The industry-education integration is a strategic measure of school-enterprise cooperation, and school-enterprise cooperation is the way to realize the integration of industry and education [10]. The industry-education integration produces a new integrated structure, by which school-enterprise cooperation can proceed smoothly. Therefore, industry-education integration is not a substitute for school-enterprise cooperation, but the structural basis of school-enterprise cooperation [11]. This leap in understanding provides a new way for the development of vocational education in China.

3.3.4. From the Dimension of Industrial College Construction

From the perspective of the construction of industrial colleges, the industry-education integration is the innovation of the school-enterprise cooperation model in which higher engineering education is closely linked to industrial development and serves to transform and upgrade the regional economy under the background of 'New Engineering'. Industrial college is a new type of school established by enterprises relying on or cooperating with universities and aiming at resource sharing and win-win cooperation, which has a sound independent operation mechanism and serves an industrial enterprise [12]. Industrial colleges have the organizational form of the integration of the industrial chain, innovation chain and education chain, and the three cross integration results in four overlapping areas, forming the cross-border heterogeneous sharing integration with bilateral or trilateral synergies [13]. The characteristics of mixed ownership of industrial colleges require that they be endowed with the status of independent legal person, establish a reasonable governance structure, and innovate the collaborative mechanism [14]. Higher vocational colleges, local undergraduate colleges, and research-oriented colleges should define their respective functions according to different talent training objectives in the construction of industrial colleges. However, no matter what type of industrial colleges, they should take cultivating students' problem-solving ability as the fundamental goal, rather than merely allowing students to master basic theoretical knowledge [15].

4. Conclusion

It is found that the integration education research hotspots focused primarily on the field of education. The enthusiasm and active efforts of reform at the institutional level were reflected in the "One Belt and One Road" initiative of Chinese enterprises, from the improvement of vocational education from school-enterprise cooperation to industry-education integration, from the transformation and development of local universities, and from the construction of industrial colleges under the background of 'new engineering'. In contrast, there are relatively few studies on the integration of industry and education in the industrial field.It can be predicted that in the future, 'the construction of industry-education integrated enterprise' is likely to become a research hot points in the field of industry-education integration, leading to extensive and in-depth research on the issue of industry-education integration in the industry field.

Acknowledgements

This thesis is a phased research result of the subject "Research on the Teaching Quality Governance Framework and Analysis Model of Vocational Colleges from the Perspective of Collaborative Governance (XY-YN-13-201924)".

References

[1] Zhimin,Liu. Focus on innovation-driven strategies to promote the integrated development of industry and education. Chinese Higher Education. 2016 (23): 31-32.

[2] Pengfei, Zhao, Zeng Xianle and Huang He et al. Exploring the mode of vocational education schools and enterprises cooperating overseas in the context of the "Belt and Road". China Vocational and Technical Education. 2017(18): 33-36+41.

[3] Qiu,Wang and Dai Yuwei. Internationalization of Vocational Education: Docking, Sharing and Going out. Chinese Vocational and Technical Education. 2018(16): 50-56.

[4] Feng,Chen. Seize the Opportunity, Take Advantage of the Trend, and Promote the Integration of Industry and Education to a New Stage. China Higher Education. 2018(02): 18-22.

[5] Xu Guoli. Empirical Analysis and Strategy Tesearch on the Integration of Industry and Education in Vocational Education of Local Applied Undergraduate Colleges and Universities. Education Review. 2017(08): 28-32.

[6] Li Beiqun. Innovation and Practice of Industry-Education Integration Pilot Area. Chinese Higher Education. 2017(08): 25-26.

[7] Liu Yourong, etal. Research on the Model of Integration of Industry and Education in Applied Undergraduate Colleges and Its Influencing Factors. China Higher Education Research. 2015(05): 64-68.

[8] Liu Zhimin. Focus on Innovation-driven Strategies to Promote the Integrated Development of Industry and Education. Chinese Higher Education, 2016 (23): 31-32.

[9] Shi Weiping, Hao Tiancong. From School-enterprise Cooperation to the Integration of Industry and Education: the Thinking Shift in the Reform of My Country's Vocational Education Model. Education Development Research, 2019, 39(01): 1-9.

[10] Liu Shiqi. Similarities and Differences between School-enterprise Cooperation and the Integration of Industry and Education. Journal of Higher Education, 2018(10): 191-193.

[11] Ouyang He, Dai Chuntao. The Connotation, Motivation and Promotion Strategy of the Integration of Industry and Education. Education and Vocational, 2019(07): 51-56.

[12] Zhu Weihong, Peng Yunfei. Research on the Construction of Industrial Colleges in Local Undergraduate Colleges under the Background of New Engineering. College Education

Management, 2018, 12(02): 30-37.

[13] Hu Wenlong. On the Logic of Organizational System Innovation of the Industrial College: A Perspective of three-chain Integration. Higher Engineering Education Research, 2018(03): 13-17.

[14] Zhu Yuedong. Practical Puzzles and Countermeasures for the Construction of Secondary Industrial Colleges with Mixed Ownership in Higher Vocational Education. China Vocational and Technical Education, 2019(01): 61-67.

[15] Zhang Yun, et al. Construction and Practice of Multi-disciplinary Integration Training Model of New Engineering. Higher Engineering Education Research, 2019(02): 50-56.