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Collaborative governance innovation in China's higher vocational education in the digital era: Analyzing the direct and indirect impacts on organizational value creation

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Abstract: This study will explore the direct and indirect impacts of collaborative governance innovation on organizational value creation in higher vocational education in China in the context of the digital era. This paper employs a mixed research methodology to construct and validate a model of the relationship between collaborative governance, digital competence, value chain restructuring, and value creation. This study first adopted an exploratory sequential design. In the qualitative interviews, 15 experts from education, business, and other related fields were used as respondents to explore accurate variable factors and determine the value of the research framework. The quantitative research used structural equation analysis to analyze 979 valid online questionnaires. Finally, the rationality of the research results was verified through case studies. The findings are clear: collaborative governance significantly positively impacts value creation, indirectly affecting organizational value creation through value chain restructuring. Furthermore, digital capabilities significantly contribute to the value chain restructuring process. This paper provides a theoretical basis and practical guidance for higher vocational education organizations to improve their governance and innovation capabilities.

Keywords: collaborative governance; higher vocational education; digital capabilities; value chain reconstruction; organizational value creation

1. Introduction

1.1. Research background

China's higher vocational education is currently undergoing rapid development. Yet, it faces several significant challenges, including the disconnect between industry needs and talent cultivation (Li and Li, 2023), the pressure to enhance teaching quality, and the increasing demand to improve students' employability (Abelha et al., 2020). As the economy undergoes structural transformation and industrial upgrading, higher vocational education is tasked with cultivating application-oriented talents. To address these challenges, collaborative governance has emerged as an innovative management model that effectively integrates resources through multi-party cooperation among schools, enterprises, governments, and social organizations, thereby improving educational quality and job market alignment (Jackson et al., 2023). The potential of collaborative governance has been further amplified by digital transformation. Digital technologies are reshaping organizational management practices (Heredia et al., 2022), providing higher vocational institutions with more flexible and efficient management tools.

1.2. Research objectives

The primary objectives of this study are: (1) To explore the direct impact of collaborative governance innovation on value creation within higher vocational education organizations in the digital age, by assessing how collaborative governance enhances value creation through value chain reconstruction. (2) To evaluate the mediating role of value chain reconstruction between collaborative governance and value creation. (3) To analyze the critical role of digital capabilities in constructing organizational value chains. This study aims to provide scientific evidence and guidance for both higher vocational education management practices through theoretical and empirical research (Li et al., 2024)

1.3. Research questions

This research is centered around the following core questions: First, what is the direct impact of collaborative governance on value creation within higher vocational education organizations? Second, how does collaborative governance indirectly influence value creation through value chain reconstruction? Third, what is the impact of digital capabilities on the reconstruction of the educational value chain? By thoroughly exploring these questions, this study seeks to uncover the potential of collaborative governance in the digital age and its application within higher vocational education.

1.4. Research significance

This research holds significant theoretical, practical, and policy implications. Theoretically, it will enrich the understanding of collaborative governance and digital capabilities within the context of higher vocational education, filling existing gaps in the literature. Practically, the findings will offer valuable insights for higher vocational education managers on optimizing organizational management and enhancing educational quality during the digital transformation process. From a policy perspective, this research will provide a reference for policymakers in developing strategies that promote school-enterprise cooperation and collaborative governance (Eldridge et al., 2018).

2. Literature review and hypotheses development

2.1. Theoretical basis of collaborative governance

Collaborative governance is a management model centered on collective action, where various stakeholders collaborate and make joint decisions to address public issues or achieve shared interests (Ansell and Gash, 2008). This model typically involves the participation and resource-sharing of multiple entities, including governments, businesses, non-governmental organizations, and communities. It also emphasizes the shared responsibility and risk in decision-making, thereby optimizing the allocation of social resources and effectively solving problems (Emerson et al., 2012). An important theoretical framework within this field is the cyclical interaction model proposed by Ansell and Gash (2008). This model analyzes the iterative interactions across different stages of the collaborative governance process, revealing

how collaborative governance can be sustained and optimized within complex organizational environments. It suggests that collaborative governance is not a one-time event but a dynamic process that requires continual adjustment and improvement. By examining these interaction phases, a deeper understanding of the long-term effects and potential challenges of collaborative governance can be achieved.

In organizational management, the application of collaborative governance is both widespread and impactful. O'Leary and Vij (2012) explored the theoretical development and practical challenges of collaborative public management. They argued that collaborative governance is not merely a theoretical concept but a management model that requires ongoing practice and validation. Its effectiveness depends on the willingness of participants to cooperate, the adaptability of organizational culture, and the design of governance structures. Considering these factors holistically can better promote the application and development of collaborative governance across various domains. For example, in the field of higher vocational education, collaborative governance can facilitate deeper cooperation between schools and businesses, thereby enhancing educational quality and employment rates (Huxham and Vangen, 2013).

Schools can stay informed about industry needs through partnerships with businesses and integrate these into curriculum design and instruction, improving students' practical skills and market competitiveness. Businesses, in turn, can support the training and skill development of future employees by collaborating with schools, contributing to optimal human resource allocation and long-term strategies.

Theoretical models support collaborative governance. Emerson, Nabatchi, and Balogh (2012) created a framework highlighting driving factors, interactions, and design in governance outcomes. Their framework states success depends on trust, balanced interests, and effective communication. Analyzing these elements improves understanding of collaborative governance's dynamics and impacts.

2.2. Digital capabilities and organizational management

Digital capability (DCA) is defined by Eisenhardt and Martin (2000) as the ability to integrate, reconfigure, acquire, and release resources to adapt to or create market changes. DCA encompasses also the speed of information acquisition and its relationship with organizational processes and personnel (AL-Khatib et al., 2024). This capability extends beyond IT skills to include the use of social media, mobile technologies, and the analytical ability to extract value from big data (Sestino et al., 2023; Srivastava and Shainesh, 2015). Consequently, digital capability enables organizations to create value through digital channels, enhancing processes and customer relationships, and impacting both operational and strategic domains (Onesi-Ozigagun et al., 2024).

Globalization and technology have transformed higher education, especially digital education. Digital transformation now restructures the educational value chain (Merici Minggu et al., 2020). Digital capability is crucial for organizations to use IT and data for efficiency and value creation (Nambisan and Baron, 2022). In the 21st century, digital competence in higher education is essential, especially post-COVID-19, as IT's role in teaching and learning grows.

It is estimated that by 2025, digital capability could have an economic impact ranging from $2.7 to $6.2 trillion globally (AbadSegura et al., 2020; Kiryakova et al., 2017). In this context, universities must formulate strategies to address the challenges posed by IoT and adapt to the rapid changes in the education industry through the concept of "smart universities." This process involves connecting various hardware devices, operating systems, and browsers, while also leveraging IoT for knowledge dissemination and student retention to foster personalized educational interactions.

As universities build competitive advantages, they face challenges like choosing attractive industries, identifying profit drivers, and defining industry positions. Studies show that an industry's profitability often determines its enterprises' profitability (Chatzoglou and Chatzoudes, 2018; Huggins and Izushi, 2015; Mok, 2008). Research on digital technologies in higher vocational education has shown that AI, big data, and MOOCs transform teaching methods and offer new opportunities for optimizing models (Chatzoglou and Chatzoudes, 2018). Concurrently, these technologies raise expectations for digital literacy, data analysis abilities, and digital resource use by teachers and students.

The role of digital competence in value creation and governance (Benavides et al., 2020). As the digital economy grows, digital competence is widely used and studied (Chen et al., 2012; Inamorato Dos Santos et al., 2023). Some scholars think it directly affects organizational value, but most say it needs mediation to do so. The fourth research hypothesis will examine how digital competence reshapes education's value chain. This will be based on interviews exploring digital capability's sub-dimensions.

2.3. Value chain reconstruction and value creation

2.3.1. Value chain reconfiguration theory

The theory of value chain reconfiguration is rooted in Michael Porter's value chain model, introduced in the 1980s, which emphasizes achieving competitive advantage through optimizing internal activities within an organization (Porter, 1985). In the digital age, technology and industry shifts, along with deeper integration between educational institutions and industry partners, are reshaping the value chain. Higher Vocational Education (HVE) involves aligning processes with industry needs, optimizing resources, and enhancing value for students and employers. HVE institutions can develop flexible, responsive, and efficient models that meet modern labor market demands (Smith and Williams, 2020).

2.3.2. Organizational value creation: Concepts and pathways

In the context of digitalization, the concept of organizational value creation has become increasingly multifaceted. Traditionally, value creation relied primarily on the production and sale of tangible goods. However, in the digital economy, value is increasingly generated through the production and application of data, information, and knowledge (Song et al., 2023; Vial, 2019). Enhanced digital capabilities enable organizations to better leverage these intangible assets, fostering continuous value creation through innovative business models and service offerings (Li et al., 2019).

In higher vocational education (HVE), value creation means generating benefits for stakeholders like students, employers, and society. Traditionally, HVE aimed to

equip students with technical skills and knowledge for specific industries. However, in the digital era, value creation in HVE also includes developing soft skills, digital literacy, and innovation (Chen and Zhao, 2021). As technology and labor market demands change, HVE must shift from content-driven models to those emphasizing transferable skills across industries. To meet these needs, HVE institutions might invest in new technologies, innovate teaching methods, or strengthen employer ties. These efforts can reconfigure HVE's value chain by integrating new resources, capabilities, and partnerships to enhance value creation potential (Gao and Wang, 2023).

2.4. Research theories

This study is primarily grounded in Collaborative Governance Theory and Value Chain Reconfiguration Theory. Collaborative Governance Theory emphasizes the cooperation and joint governance of multiple stakeholders to achieve shared goals (Ansell and Gash, 2018). In the context of higher vocational education, this theory provides a foundation for collaboration among schools, enterprises, government entities, and other stakeholders, particularly in terms of resource integration and strategic alignment. By establishing effective collaborative mechanisms, it aims to improve educational quality and employment outcomes (Bryson et al., 2020). Value Chain Reconfiguration Theory, on the other hand, focuses on how organizations, within the backdrop of digitalization, can create new value through the restructuring of their value chains (Porter and Heppelmann, 2015). In higher vocational education, as technological advancements and market demands evolve, educational institutions must continually adjust and optimize their curricula, teaching methods, and collaborative models to maintain competitiveness and societal relevance. The enhancement of digital capabilities facilitates the reconfiguration of the value chain, aligning education more closely with industry needs, and thereby further driving organizational value creation (Nambisan et al., 2017; Wheeler, 2017). This study attempts to explore the mechanism of collaborative governance innovation and value creation in higher vocational education in the context of digitalization under the theoretical framework of **Figure 1**.
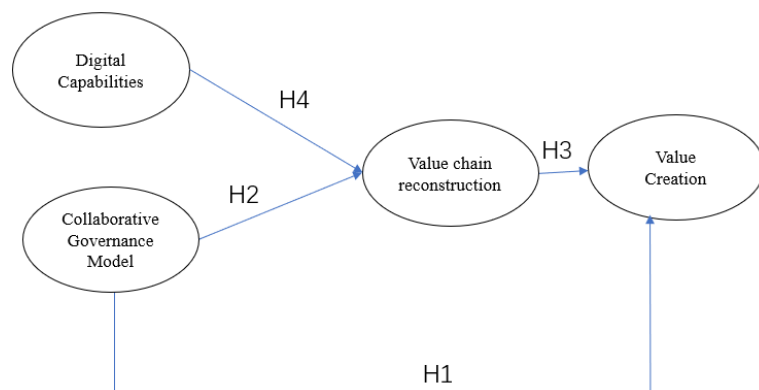
2.5. Conceptual framework

Figure 1. The conceptual framework of the thesis.

2.6. Research hypotheses

This study proposes the following hypotheses to explore the relationship between collaborative governance, digital capabilities, value chain restructuring, and value creation.

H1: Collaborative governance has a direct and significant positive impact on value creation.

H2: Collaborative governance has a significant positive impact on value chain reconstruction.

H3: Collaborative governance has an indirect impact on the organization's value creation through value chain reconstruction.

H4: Digital capabilities have a significant positive impact on value chain reconstruction.

These hypotheses will be verified through quantitative research to explore the specific paths and relationships between collaborative governance, digital capabilities, value chain reconstruction, and value creation.

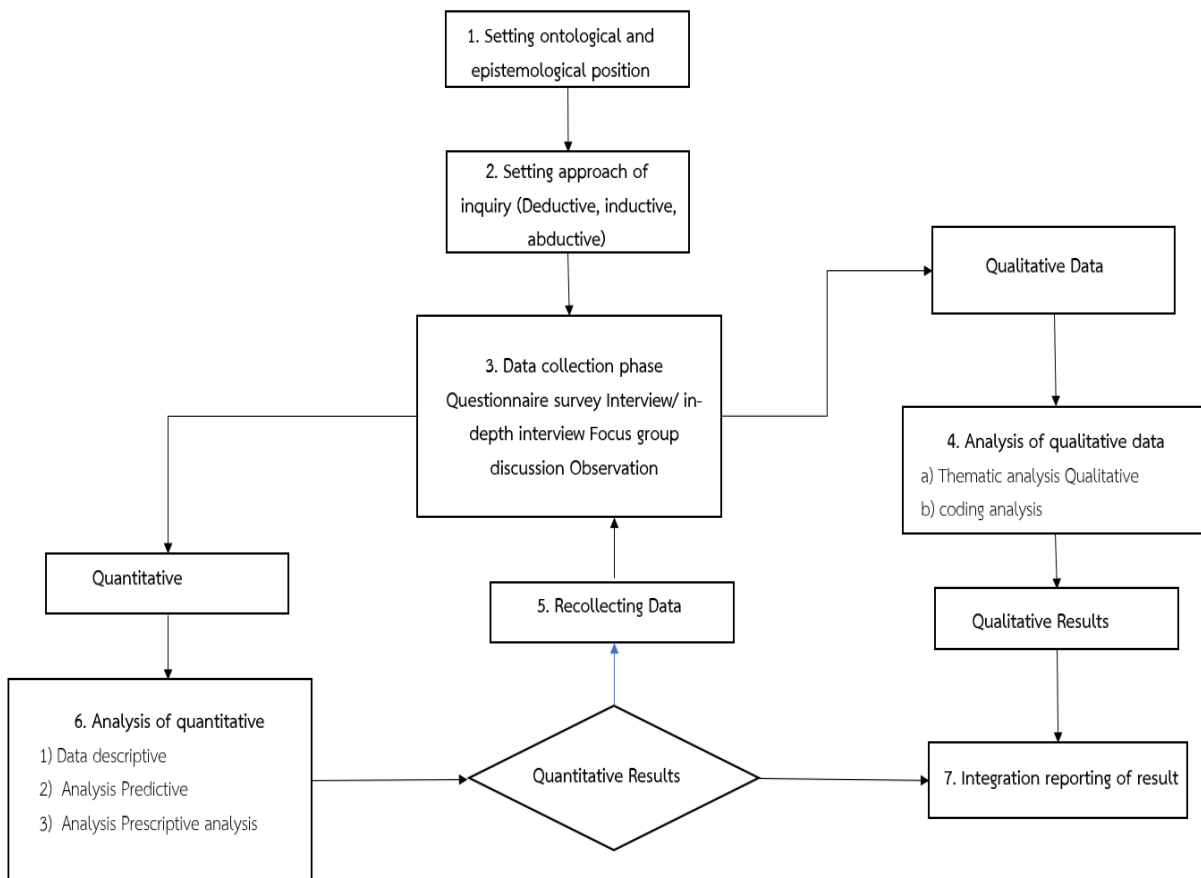## 3. Research methods

3.1. Research design

Figure 2. Workflow of mixed methods research. Source: (Toyon, 2021).

This study is committed to scientifically applying mixed research methods to explain and verify the proposed research hypotheses. Its workflow diagram is shown in **Figure 2** This method closely combines the collection and analysis of qualitative

and quantitative data, and comprehensively and deeply explores the research topic of this paper. We will use qualitative analysis methods to deepen our understanding of the variable dimensions identified in the literature review; at the same time, we will use quantitative research methods to verify how the collaborative governance model affects organizational value creation through value chain reconstruction and reveal its internal mechanism. Evaluate the direct impact and mutual relationship between digital capabilities and collaborative governance models on the level of organizational value chain reconstruction. Based on quantitative research, finally, the researchers will verify the authenticity and effectiveness of quantitative results in practical applications through qualitative analysis.

3.2. Participants and sample design

This study first adopted an exploratory mixed research. Stebbins (2001) pointed out that exploratory qualitative analysis aims to discover new elements in the phenomenon through unstructured or semi-structured methods, thereby laying the foundation for subsequent research (Patton, 2015). The semi-structured interview method, its characteristics are that it combines the systematicity of structured interviews and the flexibility of unstructured interviews (Amy et al., 2023). According to the suggestions of Cresell (2012), this study adopted a random sampling method and collected 12 interviewees from different organizations, spanning different disciplines, ages, years of work, titles, positions, and educational backgrounds. On this basis, the researcher also interviewed 3 education experts.

Based on qualitative research, this paper conducted quantitative research on relevant hypotheses. This survey used the Internet platform to create questionnaires, generate links, and distribute them. A total of 1114 questionnaires were distributed and collected. To ensure the quality of the survey, this survey excluded subjects with less than 3 years of work experience and under the age of 25, mainly to ensure that the subjects had a certain understanding of the organization and management they worked for. At the same time, the options and their consistent answers were removed to ensure the validity of the questionnaire. After that, 979 valid questionnaires remained as shown in **Table 1**, with an efficiency of 87.88%. These 979 questionnaires were used as the empirical analysis basis for this study for data analysis. Finally, This study specifically takes Xi'an S College as an example, interviews some managers, teachers, and students in the school, and verifies the results of quantitative analysis.

Table 1. Statistical analysis of basic information of respondents.

Basic Information	Group	Frequency	Percentage
Gender	Male	480	49.00
	Female	499	51.00
Age	26–35 years old	279	28.50
	36–45 years old	425	43.40
	46–60 years old	226	23.10
	61 years old and above	49	5.00

Table 1. (*Continued*).

Basic Information	Group	Frequency	Percentage
Education	College and below	18	1.80
	Undergraduate	584	59.70
	Master's Degree	305	31.20
	Doctoral student and above	72	7.40
Years of service	3–5 years	149	15.20
	6–10 years	328	33.50
	11–15 years	290	29.60
	16–20 years	111	11.30
	21 years and above	101	10.30
Job	School Administrators	394	40.20
	Teachers	309	31.60
	Business Manager	276	28.20
Title	Teaching Assistant (Assistant Engineer)	94	9.60
	Lecturer (Engineer)	674	68.80
	Associate Professor (Senior Engineer)	166	17.00
	Professor (Professorial Senior Engineer)	45	4.60

4. Data analysis and results

4.1. Explanatory qualitative research results

In the study, the phenomenological analysis reveals the respondents' common perceptions of the practice of university-enterprise cooperation in the synergistic governance between higher vocational education and enterprises, as shown in the word cloud **Figure 3** The interviews revealed that vocational institutions possess unique advantages in meeting industry demands compared to traditional universities. Respondents emphasized that vocational schools often offer more tailored programs and industry partnerships that are closely aligned with real-world job requirements. Participants widely agreed that school-enterprise collaboration provides significant competitive advantages and fosters innovation. This synergy is evident in the increased opportunities for practical training that enhance employability and industry-relevant skills. For instance, joint projects and internships effectively combine classroom learning with hands-on experience, driving both innovation and competitive advantage.

Respondents also recognized the practical significance of this research in deepening and extending school-enterprise cooperation. Feedback on the research framework indicated that it largely reflects the collaborative governance models observed in practice, with digital capabilities identified as a key factor in strengthening industry-academia partnerships, though some areas still require refinement. Specific suggestions included incorporating more granular digital competencies and sector-specific collaboration practices to better capture the nuanced interactions within school-enterprise cooperation. Based on the qualitative interviews, we improved the

components of each variable in the research framework and started quantitative analysis based on the research framework.

Figure 3. Word cloud for the initial qualitative interviews.

4.2. Quantitative research results

4.2.1. Questionnaire reliability and validity test

In the reliability test of the questionnaire, this study used SPSS software to perform statistics on Cronbach's coefficient of each variable and dimension to determine whether the empirical data collected from each variable and dimension meets the requirements of internal consistency and reliability. The specific results are as follows.

Table 2. Reliability test results of the overall questionnaire.

Dimensions	Cronbach's Alpha	Standardized Cronbach's Alpha	Number of items	Number of samples
Total table	0.957	0.957	47	979
Digital Capabilities	0.909	0.909	15	979
Collaborative governance model	0.755	0.756	4	979
Reconstruction of the value chain	0.948	0.948	18	979
Value creation	0.905	0.906	10	979

The test results in **Table 2** show that the overall coefficient of this scale is 0.957, which is significantly higher than 0.80, and the coefficients of each subscale are all above 0.70. Therefore, the reliability of the scale is good, and valid conclusions can be drawn.

In the validity test, we used the KMO value and Bartlett's sphericity test value to conduct exploratory factor analysis on the scale to determine whether the measurement variables of each latent variable have stable consistency and structure. The results are shown in **Table 3**:

Table 3. Validity test results of the overall questionnaire.

KMO		0.958
Bartlett's test of sphericity	Approximate chi-square	29346.213
	degrees of freedom	1081
	Significance	0.000

The test results show that: The KMO test value is 0.958, which is greater than the standard of 0.70. The results of Bartlett's sphericity test show that the probability of significance is 0.000 ($P < 0.01$), so the scale is considered suitable for factor analysis and has a good validity structure.

At the same time, test factor analysis also verified that the explanatory relationship between each variable factor in the questionnaire and the corresponding measurement items is in line with the variable structure preset by the researcher, and the structure of the questionnaire meets a certain degree of validity.

4.2.2. Key findings from analyzing quantitative data

Correlation analysis

This study used Pearson correlation analysis to verify whether the variables involved in this study have a mutual correlation and provide a statistical basis for the subsequent regression analysis.

Table 4. Correlation analysis.

	Collaborative governance model	Reconstruction of the value chain	Value creation	Digital Capabilities
Collaborative governance model	1			
Reconstruction of the value chain	0.362**	1		
Value creation	0.423**	0.453**	1	
Digital Capabilities	0.477**	0.550**	0.661**	1

Note: *$P < 0.05$, **$P < 0.01$.

The results of the correlation analysis in the **Table 4** above are as follows: the Pearson correlation coefficient values between the four key variables used in this research survey are all above 0.1, and the corresponding significant P values are all less than the significance of 0.05. Statistical standards show that the correlation coefficient has significant statistical significance, so it can fully explain that there is a significant correlation between the four key variables used in this research investigation.

AMOS structural equation model

According to the theoretical model, AMOS 21 was used to establish a structural equation model (picture).
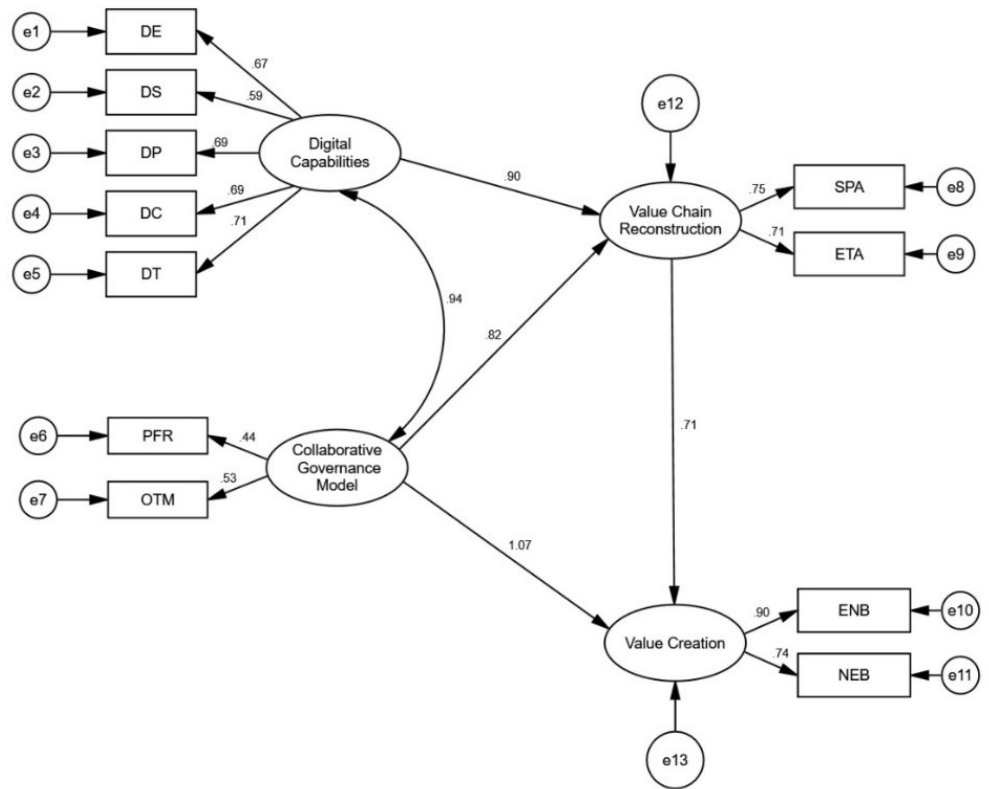
Figure 4. Structural model evaluation.

4.2.3. Structural equation model fitting index

Table 5. Structural equation model fitting index.

Fit index	Judgment criteria	actual value
Chi-square degrees of freedom ratio X^2/ df	<5 acceptable; <3 ideal	4.195
Goodness of fit index GFI	>0.8 acceptable; >0.9 ideal	0.914
Adjusted goodness-of-fit index AGFI	>0.8 acceptable; >0.9 ideal	0.897
Normed Fit Index (NFI)	>0.8 acceptable; >0.9 ideal	0.901
Modified Fit Index IFI	>0.9	0.923
Comparative Fit Index (CFI)	>0.9	0.923
Non-normative fit index NNFI (TLI)	>0.9	0.914
RMSEA	<0.08	0.057

According to the **Table 5** above, the X^2 / df value is 4.195, which is less than the ideal standard of 3; GFI = 0.914, AGFI = 0.897, NFI = 0.901, IFI = 0.923, CFI = 0.923, TLI = 0.914; the RMSEA test result value is 0.057, which is less than the standard level of 0.08. All the goodness of fit indicators in the structural equation model established in this study have reached and exceeded the universal standard value, so it can be fully demonstrated that the establishment of the structural equation model is effective and has a good match with the collected questionnaire data.

4.2.4. Path test results of each hypothesis

Table 6. Path hypothesis test results.

Assumption Path			Unstandardized path coefficients	SE	*t*	*P*	Assumptions	Standardized path coefficients
Value creation	←	Collaborative governance model	1.246	0.060	4.168	***	H1	1.071
Reconstruction of the value chain	←	Collaborative governance model	0.973	0.053	7.213	***	H2	0.821
Reconstruction of the value chain	←	Digital Capabilities	0. 780	0.045	13.182	***	H4	0.892
Value creation	←	Value chain reconstruction	0.888	0.075	11.800	***	H5	0.714

Note: ***$P < 0.001$, **$P < 0.01$, *$P < 0.05$.

The path test results of each hypothesis are shown in **Table 6**, and the specific explanations are as follows:

The collaborative governance model on value creation is 1.071 (*t* value = 4.168, *P* < 0.001), indicating that the collaborative governance model has a significant positive impact on value creation. Therefore, hypothesis H1 proposed in this study is verified.

The collaborative governance model on value chain reconstruction is 0.821 (*t* value = 7.213, *P* < 0.001), indicating that the collaborative governance model has a significant positive impact on value chain reconstruction. Therefore, the hypothesis H2 proposed in this study is verified.

Digital capabilities on value chain reconstruction are 0.892(*t* value = 13.182, *P* < 0.001), indicating that digital capabilities have a significant positive impact on value chain reconstruction. Therefore, the hypothesis H4 proposed in this study is verified.

Value chain reconstruction on value creation is 0.714 (*t* value = 11.800, *P* < 0.001), indicating that value chain reconstruction has a significant positive impact on value creation. Therefore, the hypothesis H5 proposed in this study is verified.

4.2.5. AMOS bootstrap method mediation effect test

The following **Table 7** shows the test analysis conducted by this study on whether there is a significant mediating effect between various variables in the data using AMOS software.

Table 7. Bootstrap method mediation effect test (H3).

Mediating effect path	Effect size	SE	95% confidence interval		*P*
			Lower	Upper	
Collaborative governance model-value chain reconstruction-value creation	0.307	0.004	0.041	1.188	0.002

The test result is a mediation effect test using the Bootstrap method based on AMOS software. Samples are repeatedly sampled 5000 times to calculate a 95% confidence interval. From the test results in the above **Table 7**, we can see that when the collaborative governance model is used as the independent variable, the value

chain In the model where reconstruction is the intermediary variable and value creation is the dependent variable, the indirect effect value of the intermediary path (collaborative governance model-value chain reconstruction-value creation) is 0.307, and the 95% confidence interval is all positive, excluding 0, and the significance *P* value is less than the standard of significance level 0.05, indicating that the intermediary effect exists significantly, and value chain reconstruction plays a significant intermediary role between the collaborative governance model and value creation. Therefore, it is proved that the hypothesis H3 proposed in this study is established.

4.2.6. Research hypothesis summary results

Table 8 is verified by AMOS and found that the collaborative governance model has a significant positive impact on value chain reconstruction. At the same time, digital capabilities were also found to have a significant positive impact on value chain reconstruction. Finally, the value chain Refactoring was found to have a significant positive impact on value creation and to play a significant mediating role between the collaborative governance model and value creation.

Table 8. Summary of hypothesis.

Hypothesis	Contents	Results
H1	Collaborative governance model has a significant positive impact on value creation	established
H2	The collaborative governance model has a significant positive impact on value chain reconstruction	established
H3	Value chain reconstruction plays a significant intermediary role between the collaborative governance model and value creation	established
H4	Digital capabilities have a significant positive impact on value chain reconstruction	established
H5	Value chain reconstruction has a significant positive impact on value creation	established

4.3. Qualitative research

This section summarizes the relationships between collaborative governance models, digital capabilities, and value chain reconstruction, as well as the direct impact of collaborative governance on organizational value creation. Through quantitative analysis, we obtained initial statistical results, which were further explained and validated through an explanatory mixed method approach. Specifically, interviews conducted at Xi'an S College provided deeper insights into the complex relationships among these variables.

The interview results, as shown in **Table 9**, show that collaborative governance models have a direct impact on organizational value creation. Additionally, the mediating role of value chain reconstruction suggests that collaborative governance models can indirectly influence value creation through the reconstruction of the educational value chain. Under certain conditions, both collaborative governance models and digital capabilities positively affect value chain reconstruction. These hypotheses, validated through a combination of quantitative and qualitative methods, enhance our understanding of the mechanisms of collaboration between vocational

education and enterprises and provide robust theoretical support for practical decision-making.

Table 9. Results of qualitative interviews.

Main views of interviewees	Remarks
Higher vocational education significantly improves the competencies of students through cooperation with enterprises. Affirming the positive impact of the collaborative governance model on value creation	Mixture studies are consistent.
The research framework better reflects China's collaborative governance model, and the strategy of "integration of industry and education" is an important theoretical basis for the reconstruction of the value chain by the collaborative governance model.	Mixture studies are consistent.
Value chain restructuring is strengthened by digital capabilities such as technological advancement, thus affecting the value creation of the organization.	Mixture studies are consistent.
The innovation of school curriculum content and research progress, teachers' possession of practical teaching cases, the introduction of enterprise employment standards, and the cultivation of students more in line with the needs of enterprises illustrate the value creation brought about by the reconstruction of the value chain.	Mixture studies are consistent.

5. Research findings and discussions

This study adopts a mixed research methodology combining quantitative and qualitative approaches to explore, analyze, and explain the three research questions of this dissertation, systematically validate the complex relationship between collaborative governance models, digital capabilities, value chain reconfiguration, and organizational value creation, and arrive at a series of important findings.

The path coefficient between the Collaborative governance model and value creation is 1.071 ($p < 0.01$), which indicates that the collaborative governance model has a direct impact on organizational value creation. That is, hypothesis H1 is valid. This echoes Das and Teng's (2000) view on the importance of resource integration in organizational collaboration. The study shows that the collaborative governance model directly contributes to organizational value creation by improving the efficiency of resource integration in organizations, enhancing the innovation capacity of collaborators, and shortening the decision-making and execution processes.

The SEM analysis results show the path coefficient between the collaborative governance model and value chain reconfiguration is 0.821, significant at $p < 0.01$, verifying hypothesis H2. This suggests that the collaborative governance model can promote value chain reconfiguration through resource integration and process optimization. It validates Porter's (1985) view on the importance of value chain reconfiguration, indicating that collaborative governance adds value by optimizing core activities like supply chain, production process, and customer relationship management.

H3 was validated through the Bootstrap method, demonstrating value chain reconfiguration. This confirms that value chain reconfiguration plays a significant mediating role between the collaborative governance model and organizational value creation, with an indirect effect value of 0.307 ($p < 0.05$). It shows that the collaborative governance model further contributes to organizational value creation

through value chain reconfiguration. This finding supports the hypothesis of a complex correlation between the collaborative governance model and value chain restructuring on value creation, echoing theoretical models in related literature (Dyer and Singh, 1998; Porter, 1985).

The results of the study show that the coefficient of digital competence on the path of value chain restructuring is 0.892 ($p < 0.01$), indicating that the enhancement of digital competence significantly accelerates the value chain restructuring process of an organization, and Hypothesis H4 is verified. It is demonstrated that digital capabilities play a crucial role in driving innovation and competitiveness in educational organizations (Schmidt and Wagner, 2022).

This study expands the application of collaborative governance theory, particularly in the field of higher professional education. Previous research on collaborative governance has mostly focused on public administration or business collaboration (Ansell and Gash, 2008). From a practical perspective, this research emphasizes how collaborative governance combined with digital tools can significantly improve educational outcomes. Schools can utilize digital platforms to streamline communication with businesses and government agencies, thereby aligning curricula with market needs and improving students' job readiness (Benavides et al., 2020; Chen and Zhao, 2021). This study provides a roadmap for designing a governance framework for policymakers and educational leaders that integrates stakeholders to work together on educational strategies, curricula, and talent development programs (Nambisan et al., 2017).

6. limitations and future directions

This study focuses on higher vocational education in China, revealing unique challenges and opportunities for the country's vocational education. However, the generalizability of these findings may be limited. China's education system, policy environment, and industrial structure are significantly different from those of other countries, which means that the findings may not directly apply to other parts of the world or different education systems. This variability in cultural and institutional contexts may affect the performance and effectiveness of collaborative governance models and digital competencies in different environments (Toepper et al., 2021). The sample selection for this study has some limitations, with a randomly selected sample, and the survey conducted online remains focused on vocational colleges and enterprises in specific regions, failing to provide comprehensive coverage of the current state of vocational education on a national scale.

Future research could be expanded and deepened in several key areas to compensate for the limitations of this study and explore new research directions. Similar studies could be conducted in a broader international context to validate the applicability of this study's findings across different education systems and cultural contexts. Including a larger sample of regions and industries can provide a comprehensive view of the complexity and diversity of vocational education in different contexts. While based on the Chinese system, the principles of collaborative governance and digital competence should be universally applicable (Bryson et al., 2020; Vial, 2019). In an international context, educational institutions can adapt these

models to their unique needs and help bridge the gap between education and employment in an increasingly digitalized world (Wheeler, 2017).

Author contributions: Conceptualization, ML and MSK; methodology, ML; software, ML; validation, ML and MSK; formal analysis, ML; investigation, ML; resources, ML and MSK; data curation, ML; writing—original draft preparation, ML; writing—review and editing, ML; visualization, ML; supervision, MSK; project administration, ML and MSK; funding acquisition, ML. All authors have read and approved the published version of the manuscript.

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