

The Pathways and Mechanisms for Collaborative Innovation in Vocational Education, Higher Education, and Continuing Education

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Abstract: Against the backdrop of rapid global economic development, the demand for education has gradually shifted from quantitative growth to qualitative improvement. Vocational education, higher education, and continuing education are crucial components of China's education system, each serving different educational functions. However, the collaborative innovation among these three types of education is still in the preliminary exploration stage, with issues such as scattered resources and imperfect coordination mechanisms. This paper systematically reviews relevant domestic and international research and practical experiences, thoroughly analyzes the pathways, models, and mechanisms of collaborative innovation among these three types of education, and proposes practical and operational suggestions based on the actual situation in Xuzhou City. The study finds that collaboration between vocational education, higher education, and continuing education through innovation not only enhances the overall efficiency of educational resources but also promotes regional economic development and social progress. On this basis, this paper proposes specific measures such as building an education resource-sharing platform, promoting a chain-based talent training system, strengthening policy and institutional guarantees, and improving incentive mechanisms, aiming to provide a reference for local education administrators and contribute to the innovative development of education in China.

Keywords: Vocational education; Higher education; Continuing education; Collaborative innovation; Pathways; Mechanisms; Xuzhou City

Online publication: September 30, 2024

1. Introduction

1.1. Research background

With the rapid development of globalization and information technology, society's demand for talent has undergone profound changes. Traditional education models are increasingly unable to fully meet the needs of economic and social development. In this context, vocational education, higher education, and continuing education, as important components of China's education system, face new challenges and opportunities. Vocational education focuses on cultivating skilled talents, higher education emphasizes the development

of theoretical knowledge and research capabilities, while continuing education provides opportunities for professionals to update their knowledge and improve their skills.

“Tri-education” collaborative innovation refers to the coordinated efforts between vocational education, higher education, and continuing education (referred to as “tri-education”) in the strategic layout of “education, talent, and technology” to meet the significant needs of the nation, industries, and regions. It integrates and aligns the elements of the education chain, industrial chain, talent chain, and innovation chain, with the cooperation and support of local governments, information technology service intermediaries, financial institutions, and other entities. The goal is to optimize the allocation of educational resources and achieve the integration of vocational and general education, industry-education integration, and science-education integration, thereby accelerating technological innovation, the application of technology, and industrial transformation and upgrading ^[1]. However, there have long been issues such as uneven resource allocation, incomplete collaboration mechanisms, and low efficiency in the transformation of educational achievements between these three forms of education, which have constrained the overall effectiveness of the education system.

In recent years, national education policies have shifted from a focus on single-discipline education to the cultivation of comprehensive qualities, especially emphasizing the close connection between talent cultivation and societal needs. The report of the 20th National Congress of the Communist Party of China proposed “coordinating the collaborative innovation of vocational education, higher education, and continuing education” ^[2]. Under these new circumstances, effectively coordinating vocational, higher, and continuing education to form a mutually complementary and collaborative education model has become a critical issue in educational reform. On May 29, 2023, the General Secretary once again emphasized building a strong educational country during a collective study session of the Political Bureau of the CPC Central Committee: “We must coordinate vocational education, higher education, and continuing education, promote the integration of vocational and general education, industry-education integration, and science-education integration, and continuously cultivate high-quality skilled personnel, great craftsmen, and skilled workers” ^[3]. This issue is not only related to the optimization and innovation within the education system but also directly impacts regional economic competitiveness and sustainable social development. Therefore, researching the collaborative innovation pathways and mechanisms of vocational education, higher education, and continuing education holds significant practical importance.

1.2. Research objectives and significance

The main objective of this research is to explore the collaborative innovation models and pathways between vocational education, higher education, and continuing education, analyze the potential problems encountered in practical operation, and propose corresponding solutions. Specifically, this research aims to:

- (1) Systematically review the current status and functional positioning of vocational education, higher education, and continuing education, analyzing the relationships between them and the necessity of their collaborative innovation.
- (2) Draw from successful collaborative innovation cases domestically and internationally, proposing suitable collaborative innovation pathways and models for Xuzhou City and similar regions.
- (3) Provide specific measures and suggestions for ensuring the collaborative innovation of vocational education, higher education, and continuing education from the perspectives of policy, institutions, and mechanisms.

This research has both theoretical and practical significance. Theoretically, by deeply analyzing the

collaborative innovation of vocational education, higher education, and continuing education, this research can enrich the application scenarios of collaborative innovation theory and expand its practical application in the field of education. Practically, this research can provide specific operational suggestions for local education administrators, assisting in the optimization and upgrading of regional education systems, thereby promoting the sustainable development of local economies and societies.

1.3. Research methods

To achieve the above research objectives, this paper adopted a variety of research methods for comprehensive analysis:

- (1) Literature research: By reviewing a large number of relevant domestic and international documents, this study systematically organized the theoretical foundations and practical experiences of collaborative innovation in vocational, higher, and continuing education, providing theoretical support for the research.
- (2) Case study: This method involved selecting successful collaborative innovation cases in education, such as Germany's dual vocational education system, the United States community college model, and certain regions in China's industry-education integration model, for in-depth analysis, extracting lessons and insights.
- (3) Interviews: Through interviews with educational administrators, teachers, students, and corporate representatives, first-hand data were obtained to understand the current state, problems, and causes of collaborative innovation in vocational, higher, and continuing education.
- (4) Field research: Based on the actual situation in Xuzhou City, field research was conducted to analyze the role of vocational, higher, and continuing education in local economic and social development and assess their potential for collaborative innovation. Policy suggestions that are practical and feasible were provided.

1.4. Research innovations

The innovations of this study lie in:

- (1) Exploring the collaborative innovation between vocational, higher, and continuing education from the perspective of regional economic and social development, and proposing a collaborative innovation model based on local economic development.
- (2) Proposing the construction of a unified resource-sharing platform for vocational, higher, and continuing education, utilizing modern information technology to achieve cross-boundary integration of educational resources.
- (3) Offering specific measures to ensure the implementation of collaborative innovation from the perspectives of policy, institutions, and incentive mechanisms, providing practical reference points for education policymakers.

Through the study of collaborative innovation between vocational, higher, and continuing education, this paper aims to provide new ideas and models for the reform and innovation of China's education system, helping to improve the overall efficiency of the education system and achieve coordinated development of regional economies and societies.

2. Theoretical foundation

2.1. Synergetic innovation theory

Synergetics originated in the natural sciences, and the concept of synergetics was introduced by the famous

German theoretical physicist Hermann Haken in 1971. It was formally established with the publication of *Synergetics* in 1973^[4]. Synergetic innovation theory, derived from synergetics and innovation studies, aims to study the interactions and collaborative effects between various components in complex systems. It emphasizes achieving the maximization of overall benefits through multi-party collaboration. Synergetic innovation not only focuses on the integration and cooperation of resources among different entities but also involves knowledge sharing, technology integration, and coordinated development among organizations. In the field of education, synergetic innovation theory provides a theoretical basis for the coordinated development of vocational, higher, and continuing education.

The core of synergetic innovation lies in emphasizing cooperation and interaction between multiple entities. In the field of education, this means the participation and coordination of schools, governments, enterprises, and social organizations. To accelerate the process of independent innovation in China, the Ministry of Education and the Ministry of Finance implemented the “Plan for Enhancing the Innovation Capacity of Higher Education Institutions” in 2011, promoting synergetic innovation between industry, academia, and research institutions^[5]. Synergetic innovation requires cooperation in resource allocation, curriculum development, and other aspects. It also demands innovation in policies, institutions, and management mechanisms to ensure the effective implementation of synergetic innovation.

2.2. Functional positioning and relationships of vocational, higher, and continuing education

Vocational education, higher education, and continuing education, as important components of the education system, each bear different functional responsibilities. However, there are also inherent connections and complementarities among them. Understanding their functional positioning and relationships is the premise for studying their synergetic innovation.

2.2.1. Functional positioning of vocational education

Vocational education primarily serves frontline production, aiming to cultivate technical talents with a certain theoretical foundation and strong practical skills. In terms of flexibility in professional settings, vocational colleges strive to offer niche specialties that may not be found in comprehensive universities or universities of applied sciences, achieving differentiation and dislocation development^[6]. Vocational colleges follow the principle of dual cultivation in their education and training^[7]. The teaching content focuses more on practicality and vocational orientation, with curriculum development closely aligned with industrial demand, emphasizing the cultivation of students’ vocational capabilities and overall quality. Vocational education plays a crucial role in promoting social employment, improving workers’ professional competence, and enhancing their adaptability, serving as a key support for national economic development.

2.2.2. Functional positioning of higher education

Higher education refers to specialized education received after secondary education, emphasizing knowledge transmission, scientific research, and social services. It mainly includes full-time and part-time higher education, where students can obtain both academic degrees and qualifications^[8]. Higher education is guided by academic and research orientations, emphasizing theoretical knowledge dissemination, research capacity development, and the cultivation of innovative spirit. Higher education institutions, such as universities and research colleges, not only bear the responsibility for training high-level talents but also play a key role in knowledge innovation, technological development, and cultural inheritance. Higher education provides society with numerous research outcomes and high-quality talents, serving as a core driving force for national innovation capacity.

2.2.3. Functional positioning of continuing education

Continuing education is a high-level supplementary education aimed at social members who have completed school-based education stages, providing updates and additions to professional knowledge and skills. The knowledge and skills learned in continuing education typically respond more closely to market demands ^[9]. Continuing education offers working adults further learning opportunities, focusing on knowledge updates, skill enhancement, and career transformation. It is characterized by lifelong education and helps social members continuously adapt to changes in their professional and living environments. Continuing education covers a wide range of areas, including vocational training, degree education, and non-degree education, serving as a vital pathway for building a lifelong learning society.

2.2.4. Relationships between the three types of education

Vocational education, higher education, and continuing education each have distinct focuses, but in practice, they are closely related and complementary. Vocational education emphasizes skill training, higher education focuses on theoretical research and innovation, while continuing education plays a role in career transformation and skill enhancement. However, all three types of education share the common goal of being human-centered, cultivating moral character, and focusing on the overall and long-term development of individuals ^[8]. Through synergetic innovation, the three can complement and integrate in terms of educational resources, curriculum systems, and talent cultivation.

Vocational education can improve students' theoretical level and innovation capacity through collaboration with higher education, enhancing their ability to adapt to future industrial upgrades. Higher education can enhance its social service function and broaden its influence through collaboration with vocational education and continuing education. Meanwhile, continuing education can organically connect with vocational and higher education, forming a lifelong learning system that provides continuous intellectual support and skill assurance for society.

2.3. Application and expansion of relevant theories

Under the guidance of synergetic innovation theory, the collaborative innovation of vocational, higher, and continuing education represents not only an innovation in educational philosophy but also an exploration of practical pathways. In practice, synergetic innovation theory can be applied and expanded in the following areas:

2.3.1. Building a shared educational resource platform

Based on synergetic innovation theory, a unified resource-sharing platform covering vocational, higher, and continuing education can be constructed. This platform can break down the barriers between different types of education and maximize the use of educational resources. For example, vocational and higher education institutions can share laboratories and libraries, while continuing education institutions can share faculty and course resources with higher education institutions.

2.3.2. Forming a talent cultivation chain

Through synergetic innovation, vocational, higher, and continuing education can form a complete talent cultivation chain. From the skill development in vocational education to the theoretical deepening in higher education and career advancement in continuing education, the three can connect seamlessly to create a lifelong learning loop. This not only enhances the systematic and continuous nature of talent cultivation but also improves the overall level of human resources in society.

2.3.3. Promoting and practicing synergetic innovation models

The application of synergetic innovation theory is not limited to the integration of educational resources but can also be expanded to broader areas such as industry-education integration and school-enterprise cooperation. By continuously summarizing experiences in practice and innovating synergetic innovation models, valuable lessons can be provided for educational reforms in other regions and fields.

Synergetic innovation theory provides a solid theoretical foundation for the coordinated development of vocational, higher, and continuing education. By analyzing the functional positioning and relationships of these three types of education, guidance can be offered for the selection of synergetic innovation pathways in the future. Through this theory, the education system can more effectively integrate resources, enhance overall efficiency, and achieve a win-win situation for both education and socio-economic development.

3. International experiences in the collaborative innovation of vocational, higher, and continuing education

3.1. International experience

In the context of globalization, many countries have accumulated rich experiences in the collaborative innovation of vocational, higher, and continuing education. Below are several representative international cases, which provide important insights for promoting collaborative innovation in vocational, higher, and continuing education in China.

3.1.1. Germany's "dual system" of vocational education

Germany's "dual system" of vocational education is recognized as a global success model in the field of vocational education. The "dual system" combines school-based theoretical education with enterprise-based practical training^[10]. This system tightly integrates school education with enterprise practices, allowing students to engage in both learning and doing, forming an "educate while working, work while learning" educational model. This model not only improves students' practical skills but also ensures that what is learned closely aligns with enterprise needs.

At the same time, Germany's dual system emphasizes vocational orientation, where students choose a specific vocational direction during their studies and receive targeted learning and practice in that area^[11]. In the dual system, there is a close connection between higher education and vocational education. Many German universities offer applied courses, which not only connect with vocational education content but also provide opportunities for students to further their studies. In addition, Germany's continuing education system is closely linked with vocational and higher education, offering lifelong learning opportunities for employees to continuously adapt to new industry requirements.

3.1.2. United States' community college and higher education cooperation model

The United States' (US) community college system serves as an important platform for linking vocational and higher education. It is a key component of equal access to higher education in the US community colleges, providing an entry point into higher education for many who might otherwise not be able to attend traditional institutions, which is why they are often referred to as a manifestation of egalitarianism in higher education in the US^[12]. Community colleges offer not only skill training and vocational education but also transition courses that lead to four-year university programs. Through this model, students can acquire vocational skills while continuing their academic pursuits.

Community colleges also collaborate closely with local businesses and communities to design market-

responsive courses. This flexible curriculum structure allows for effective alignment between vocational, higher, and continuing education, meeting the diverse needs of students. Additionally, the US continuing education system is widely embedded in community colleges, forming a multi-layered, diversified educational network that supports lifelong learning for all members of society.

3.1.3. Finland's lifelong learning system

Lifelong guidance is the latest development in vocational guidance and career counseling history ^[13]. Finland, known for its outstanding education system, has a comprehensive lifelong learning system as a key component. The Finnish government places great emphasis on the interaction between education and social development, and through legislation and policy support, it has established a lifelong learning system that covers the entire population. Within this system, vocational education, higher education, and continuing education are interconnected, providing equal learning opportunities for all citizens.

In Finland's education system, a longitudinally integrated vocational guidance system is formed, covering different stages of education, from basic education to higher and adult education. The content and forms of vocational guidance and counseling vary according to the education stage but maintain continuity ^[14]. Finland's vocational education system emphasizes seamless connections with higher education, allowing students to enter higher education through vocational education, or to enhance their skills and knowledge through continuing education after entering the workforce. Finland's education system focuses on flexibility and personal development, providing students with multiple learning paths and ensuring that they can freely choose their learning methods and content based on personal interests and career needs.

3.2. Current situation and challenges in China

Compared to international advanced experiences, China has made some progress in the collaborative innovation of vocational, higher, and continuing education but still faces many challenges. The following analysis will focus on policy orientation, educational resource integration, and collaboration mechanisms.

3.2.1. Policy orientation of vocational education and its synergy with higher education

Vocational education is closely related to economic and social development, bearing the responsibility of cultivating technical and skilled talents for regional economic and social development, and it is developing rapidly ^[15]. In recent years, the government has introduced a series of policies to support the development of vocational education, aiming to enhance its attractiveness and social status. However, in practice, there are still barriers to the connection between vocational and higher education. For example, vocational colleges and regular universities differ significantly in terms of educational resource allocation and teaching quality standards, resulting in limited student mobility between vocational and higher education.

3.2.2. Role of higher education in social service and vocational education

China's higher education institutions play an essential role in knowledge innovation and talent cultivation but have room for improvement in serving society, particularly in vocational education. Currently, many universities' research outcomes are disconnected from societal needs, especially in serving local economies and vocational education development, where effective collaboration mechanisms are lacking.

3.2.3. Diversified development of continuing education and its insufficient synergy with vocational and higher education

As an essential form of lifelong learning, continuing education plays a crucial role in enhancing the quality of

social members and facilitating career transitions. In recent years, China's continuing education has developed rapidly and has taken diverse forms, including adult degree education, vocational training, and online education. However, the collaborative mechanisms between continuing education and vocational and higher education are still underdeveloped, particularly in terms of resource sharing, credit transfer, and curriculum alignment, which leaves considerable room for improvement.

In traditional views, vocational education and continuing education are often regarded as “inferior” or “adult” education, and this mindset hinders the integration between these sectors and regular education^[16]. Collaboration between continuing education institutions, vocational colleges, and higher education institutions is often loose, lacking a systematic collaboration mechanism. Furthermore, the curriculum in continuing education is often disconnected from that of vocational and higher education, leading to incoherent learning paths for learners, which limits the full realization of educational outcomes.

3.3. Summary and implications from domestic and international experience

Based on the analysis of domestic and international experiences in collaborative innovation between vocational, higher, and continuing education, the following key insights can be drawn:

- (1) Policy support and institutional guarantees are key: International experience shows that government policy support and institutional guarantees play a decisive role in the collaborative innovation of vocational, higher, and continuing education. China should further improve relevant policies, especially in terms of integrating educational resources, aligning curricula, and recognizing credits. A unified set of standards and regulations is needed.
- (2) Industry-education integration and school-enterprise cooperation are effective pathways: Whether it is Germany's dual system or the US community colleges, school-enterprise cooperation and industry-education integration are critical pathways for realizing the synergetic development of vocational and higher education. China should encourage and support vocational and higher education institutions to strengthen cooperation with enterprises and improve students' comprehensive abilities and employability through joint training programs and internships.
- (3) Building a lifelong learning system and promoting synergy between continuing, vocational, and higher education: Drawing on Finland's experience, building a lifelong learning system covering the entire population is crucial for achieving collaborative innovation between vocational, higher, and continuing education. China should further promote the deep integration of continuing education with vocational and higher education, creating a multi-level and diversified educational network that meets the learning needs of different groups.

By drawing on international experiences and combining them with China's actual conditions, effective strategies and pathways can be developed for the collaborative innovation of vocational, higher, and continuing education. This will not only help improve the overall efficiency of China's education system but also promote sustainable economic and social development.

4. Pathways for coordinating the collaborative innovation of vocational, higher, and continuing education

In the context of global education reform, coordinating the collaborative innovation of vocational, higher, and continuing education has become an important means of improving education quality and promoting social and economic development. Based on the summary of domestic and international experiences, this section explores specific pathways for coordinating the collaborative innovation of vocational, higher, and continuing education,

offering suggestions from the perspectives of educational resource integration, talent cultivation systems, and technological innovation.

4.1. Pathways for integrating educational resources

The integration of educational resources is fundamental to achieving the collaborative innovation of vocational, higher, and continuing education. By sharing resources and optimizing allocation, the overall efficiency of the education system can be effectively enhanced.

4.1.1. Building a unified resource-sharing platform

To achieve the collaborative development of the three types of education, a resource-sharing platform covering vocational, higher, and continuing education should first be established. This platform should include teaching resources, curriculum content, experimental equipment, faculty resources, and other educational assets. The use of modern information technology to promote the co-construction and sharing of quality educational resources is essential for achieving high-quality collaborative innovation across “tri-education,” gradually narrowing the educational gaps between urban and rural areas, regions, types of education, levels, and groups, promoting educational equity and justice, and improving the quality of education^[17]. Using modern information technologies such as cloud computing, big data, and artificial intelligence, an open, transparent, and shareable educational resource platform can be built.

4.1.2. Promoting cross-boundary integration of educational resources

In the process of integrating vocational, higher, and continuing education, it is also necessary to break down disciplinary barriers and departmental boundaries, achieving cross-boundary integration of educational resources. Government departments, communities, community residents, and social forces can act as key players in promoting the cross-boundary integration of educational resources^[18]. By co-constructing laboratories, jointly developing research centers, and cooperating in school operations, resource complementarity and sharing can be promoted.

For example, higher education institutions can collaborate with vocational colleges to jointly establish laboratories or training bases, sharing research equipment and experimental outcomes. Meanwhile, continuing education institutions can collaborate with enterprises and universities to offer market-driven courses and training programs, realizing the socialization and marketization of educational resources.

4.2. Collaborative pathways for the talent cultivation system

In the context of increasingly fierce global competition, building a talent cultivation system that can flexibly respond to societal needs is a crucial pathway for achieving the collaborative innovation of vocational, higher, and continuing education.

4.2.1. Building a linked talent cultivation system across “tri-education”

To achieve systematic and continuous talent cultivation, it is necessary to build a talent cultivation system that links vocational, higher, and continuing education. To effectively gather innovative resources and elements from “tri-education” and improve the efficiency of coordinated development and collaborative innovation across these three types of education^[17], this system should cover the full spectrum of education, from vocational skill training to academic research and career enhancement.

4.2.2. Strengthening industry-education integration and school-enterprise cooperation

In the process of talent cultivation, industry-education integration and school-enterprise cooperation are critical

pathways for enhancing education quality and improving students' employability. Vocational and higher education institutions should collaborate closely with enterprises to design courses aligned with industry needs, develop joint training programs, and enhance students' practical skills and professional qualities. Higher education institutions should also focus on local economic development trends, aligning with local industrial needs, and forming educational synergies with enterprises to jointly build specialized programs, fostering the concept of dual-education systems ^[19].

For example, vocational education institutions can collaborate with leading enterprises in various industries to offer customized courses and training programs, providing students with real-world work environments and practical opportunities. At the same time, higher education institutions can engage in industry-university-research collaboration with enterprises to jointly develop and promote new technologies, achieving the transformation and application of research outcomes.

4.2.3. Promoting the integration of degree and non-degree education

In the talent cultivation system, efforts should also be made to promote the integration of degree and non-degree education. By implementing credit transfer, curriculum alignment, and joint certification, seamless connections between degree and continuing education can be achieved, meeting the diverse learning needs of students and professionals.

For example, vocational and higher education institutions can collaborate with continuing education institutions to design flexible learning pathways, allowing learners to continue their studies and obtain academic qualifications after completing non-degree education. This not only helps to improve the overall quality of social members but also effectively alleviates pressure in the current job market.

4.3. Pathways for integrating technological innovation and educational models

Technological innovation plays a vital role in the transformation of educational models. By integrating technological innovation with educational models, the collaborative innovation capabilities of vocational, higher, and continuing education can be effectively enhanced.

4.3.1. Applying information technology in education

The development of information technology provides new opportunities for the collaborative innovation of vocational, higher, and continuing education. Through online education platforms, virtual laboratories, smart classrooms, and other modern educational technologies, the limitations of time and space can be broken, enabling the widespread sharing of educational resources and innovation in teaching models.

For example, online education platforms can be used to integrate high-quality course resources from vocational, higher, and continuing education, offering flexible learning options for students and professionals. Additionally, the application of virtual laboratories and simulation technologies can provide students with more realistic and diverse practical experiences, enhancing their hands-on capabilities.

4.3.2. Exploring “Internet+” education models

The “Internet+” education model represents a typical example of the integration of technological innovation and educational models. Through internet technologies, comprehensive coverage and deep integration of vocational, higher, and continuing education can be achieved.

For example, an “open university” model based on the Internet can be explored, integrating resources from vocational and higher education to provide high-quality learning resources and platforms for continuing education learners. Additionally, big data analysis can be used to accurately identify the learning needs of

students and professionals, offering personalized educational services.

4.3.3. Innovating educational evaluation and management models

Technological innovation can also drive changes in educational evaluation and management models. Through intelligent educational evaluation systems, comprehensive assessments of students' learning outcomes and teachers' teaching quality can be conducted, improving the scientific and fairness of educational management.

For example, big data and artificial intelligence technologies can be used to establish real-time educational evaluation systems, dynamically monitoring and providing feedback on the teaching outcomes of vocational, higher, and continuing education. At the same time, intelligent management platforms can be used to efficiently allocate and optimize educational resources, improving the overall efficiency of the education system.

4.4. Pathways for support from local governments and social forces

In the process of collaborative innovation between vocational, higher, and continuing education, the support of local governments and social forces is crucial. Through government guidance and social participation, a favorable environment and conditions for educational collaborative innovation can be created.

4.4.1. Government policy guidance and support

Local governments serve as a bridge between vocational colleges and enterprises, playing multiple roles and acting as indispensable drivers in the high-quality development of industry-education integration in vocational colleges^[20]. Local governments should play a guiding role in policy, formulating and implementing relevant policies to encourage the collaborative innovation of vocational, higher, and continuing education. For example, special funds can be established to support the integration and sharing of educational resources and promote school-enterprise cooperation and industry-education integration.

4.4.2. Participation and cooperation of social forces

The participation of social forces is of great significance for promoting the collaborative innovation of vocational, higher, and continuing education. Social organizations, industry associations, enterprises, and other social entities can participate in educational collaborative innovation through various forms.

For example, enterprises can support vocational and higher education development by establishing scholarships, donating equipment, and offering internship opportunities. Industry associations can play a guiding role in designing and evaluating vocational and continuing education curricula, ensuring that educational content aligns closely with industry needs.

4.4.3. Integration of public services and social responsibility

In promoting the collaborative innovation of vocational, higher, and continuing education, the integration of public services and social responsibility should also be emphasized. Educational institutions, governments, enterprises, and social organizations should jointly assume social responsibility, promoting educational equity and improving overall social quality.

For example, public welfare programs and volunteer services can offer free vocational and continuing education courses, helping disadvantaged social groups enhance their skills and competitiveness. This not only contributes to harmonious social development but also creates a positive social environment for educational collaborative innovation.

5. Building a synergetic innovation mechanism

To effectively promote the collaborative innovation of vocational, higher, and continuing education, a corresponding support system must be built in terms of policies, institutions, and incentive mechanisms. This section will explore how to construct and improve the synergetic innovation mechanism from the three levels of policy support mechanisms, institutional guarantees, and incentive mechanisms to ensure the smooth implementation of synergetic innovation.

5.1. Policy support mechanisms

Policy support is the foundation for promoting the collaborative innovation of vocational, higher, and continuing education. In October 2021, the Ministry of Education stated in a reply to the proposal at the Fourth Session of the 13th National Committee of the Chinese People's Political Consultative Conference, "We will take multiple measures to promote the mutual integration of various types of education, relying on qualification frameworks and credit banks to break down barriers between higher education, vocational education, and continuing education" ^[21]. In this process, the government should play a guiding and regulating role, formulating scientific and reasonable policies to provide strong support for synergetic innovation.

5.1.1. Developing a clear policy framework for synergetic innovation

The government should develop a policy framework for synergetic innovation that encompasses vocational, higher, and continuing education, clearly defining the goals, directions, and implementation pathways for the synergetic development of these three forms of education. The policy framework should emphasize the integration of educational resources, credit recognition, curriculum alignment, and other aspects to ensure the orderly promotion of various forms of education in synergetic innovation.

For example, the government can introduce policies that encourage universities and vocational colleges to cooperate in running schools, jointly develop curricula and teaching resources, and promote a cross-institutional credit recognition system. At the same time, policies should offer flexible learning pathways and diverse certification modes for continuing education to meet the needs of different learners.

5.1.2. Providing financial support and resource allocation

Financial support is crucial for promoting synergetic innovation. The government should establish special funds to support projects for the integration of educational resources and synergetic innovation between vocational, higher, and continuing education. The funds should prioritize supporting areas such as industry-education integration, school-enterprise cooperation, and the construction of shared educational resource platforms.

Moreover, the government can encourage enterprises and social forces to participate in the development of vocational and continuing education through tax incentives, financial subsidies, and other measures. For enterprises that actively engage in synergetic innovation, preferential policies such as tax exemptions and financial support can be considered to mobilize the enthusiasm of all sectors of society to participate in synergetic innovation.

5.1.3. Promoting the formulation of localized synergetic innovation policies

Under the guidance of national policies, local governments should formulate synergetic innovation policies tailored to their own economic and social development realities. Localized policies should focus on supporting the development of local universities and vocational colleges, encouraging them to engage in in-depth cooperation with local enterprises and social organizations, and achieving positive interaction between education and local economic and social development.

5.2. Institutional guarantee mechanisms

In the process of promoting the collaborative innovation of vocational, higher, and continuing education, institutional guarantee mechanisms are essential to ensuring the smooth implementation of various policies and measures. Sound institutional design can effectively regulate and incentivize participants, ensuring the sustainable development of synergetic innovation.

5.2.1. Establishing a multi-stakeholder collaborative management mechanism

Synergetic innovation requires the participation of multiple stakeholders, including governments, educational institutions, enterprises, and social organizations. Therefore, a collaborative management mechanism should be established that includes government departments, education management bodies, schools, enterprises, and social groups to ensure coordination and cooperation among all parties in synergetic innovation.

5.2.2. Improving credit recognition and qualification certification systems

Credit recognition and qualification certification systems are key components of synergetic innovation between vocational, higher, and continuing education. Improving these systems can break down the barriers between different types of education and promote the flow of students and professionals across various forms of education.

For example, a national credit recognition platform should be established, with unified standards for credit transfer and certification procedures, allowing credits to be recognized between vocational and higher education. For continuing education, a flexible qualification certification system should be developed, allowing learners to obtain relevant professional or academic certifications through learning and practice, ensuring that learning outcomes are widely recognized.

5.2.3. Formulating incentive and evaluation mechanisms for teachers and administrators

Teachers and administrators are the core forces driving the collaborative innovation of vocational, higher, and continuing education. To motivate their participation, scientific incentive and evaluation mechanisms should be formulated, providing reasonable performance evaluations and incentives for teachers and administrators involved in synergetic innovation.

For example, career advancement, professional title evaluation, and performance bonuses can be prioritized for teachers and administrators participating in synergetic innovation. For teachers who excel in synergetic innovation projects, opportunities for promotion or additional research and training opportunities should be considered. Additionally, schools should provide specialized training for administrators involved in synergetic innovation, improving their management skills and innovative capacity.

5.3. Incentive mechanisms

To better promote the collaborative innovation of vocational, higher, and continuing education, the design of incentive mechanisms is crucial. By establishing effective incentive mechanisms, the enthusiasm of teachers, students, enterprises, and social forces can be fully mobilized, promoting the deepening of synergetic innovation.

5.3.1. Incentive mechanisms for teachers and researchers

Teachers and researchers are the core drivers of educational innovation, and their enthusiasm directly affects the effectiveness of synergetic innovation. Therefore, a multi-level incentive mechanism should be established to encourage teachers and researchers to actively participate in synergetic innovation activities.

5.3.2. Incentive mechanisms for students

Students are the direct beneficiaries of education and important participants in synergetic innovation. To stimulate students' innovation awareness and practical skills, an incentive mechanism should be established to encourage them to participate in synergetic innovation projects.

5.3.3. Incentive mechanisms for enterprises and social forces

Enterprises and social forces play important roles in synergetic innovation. To attract more enterprises and social organizations to participate in synergetic innovation, corresponding incentive mechanisms should be established.

For example, the government can incentivize enterprises to collaborate with vocational and higher education institutions on synergetic innovation projects through tax exemptions, financial subsidies, and other policies. Participating enterprises could also be given priority in government procurement, project bidding, and other areas. At the same time, social organizations can support synergetic innovation development by participating in educational funds and establishing scholarships.

5.4. Mechanisms for the sustainable development and dynamic adjustment of synergetic innovation

Synergetic innovation is an ongoing process that requires constant dynamic adjustments and optimizations to meet the new demands of socio-economic development. Therefore, when building synergetic innovation mechanisms, it is essential to consider their sustainable development and dynamic adjustment requirements.

5.4.1. Establishing regular evaluation and feedback mechanisms

To ensure the effectiveness of synergetic innovation mechanisms, regular evaluation and feedback mechanisms should be established to comprehensively assess the synergetic innovation performance of vocational, higher, and continuing education. Evaluation content should include the effectiveness of educational resource integration, talent cultivation quality, and the outcomes of industry-education integration.

5.4.2. Establishing flexible adjustment mechanisms to respond to socio-economic changes

Changes in the socio-economic environment present new challenges for the collaborative innovation of vocational, higher, and continuing education. Therefore, in constructing synergetic innovation mechanisms, flexible adjustment mechanisms should be established to ensure that the education system can promptly respond to changes in society and the economy.

For example, as industries adjust and technological progress continues, educational institutions should promptly adjust curricula and training directions based on market demands. Meanwhile, governments should dynamically adjust relevant policies and systems to ensure that synergetic innovation mechanisms adapt to new social development trends.

5.4.3. Integrating international experience with local innovation mechanisms

In the process of building synergetic innovation mechanisms, it is essential to learn from successful international experiences while considering China's actual conditions for innovation. By studying and adopting advanced synergetic innovation mechanisms from abroad, valuable lessons can be drawn for China's collaborative innovation of vocational, higher, and continuing education.

At the same time, local regions should be encouraged to engage in innovative practices based on their own characteristics, exploring synergetic innovation mechanisms that meet the needs of local economic and

social development. Through exchanges and dissemination, these innovative mechanisms can be applied and promoted more broadly.

6. Conclusion and outlook

6.1. Research conclusions

This study systematically analyzed the collaborative innovation of vocational, higher, and continuing education and proposed pathways and strategies for constructing synergetic innovation mechanisms. The main conclusions of this study are as follows:

6.1.1. The necessity of synergetic innovation

Vocational, higher, and continuing education, as essential components of the education system, each serve distinct functions but also have clear complementarities and internal connections. Through synergetic innovation, barriers between different forms of education can be broken, resources can be optimally allocated, and the overall efficiency of the education system can be enhanced.

6.1.2. The importance of resource integration and sharing

The construction of a unified educational resource-sharing platform and the promotion of cross-boundary integration of educational resources are key to realizing the collaborative innovation of vocational, higher, and continuing education. By integrating and sharing resources, the quality of education can be significantly improved, and educational outcomes can be widely disseminated and applied.

6.1.3. The connectivity of talent cultivation systems

The collaborative innovation of vocational, higher, and continuing education requires the construction of linked talent cultivation systems. Through industry-education integration and school-enterprise cooperation, a continuous education pathway can be formed, ranging from vocational skill development to academic research and career enhancement, helping to cultivate high-quality talents with both innovation capabilities and practical skills.

6.1.4. The necessity of policy and institutional support

The smooth implementation of synergetic innovation cannot be achieved without policy and institutional support. By developing clear policy frameworks, improving credit recognition and qualification certification systems, and establishing multi-stakeholder collaborative management mechanisms, strong guarantees can be provided for synergetic innovation.

6.1.5. The design of incentive mechanisms

To fully mobilize the enthusiasm of teachers, students, enterprises, and social forces, effective incentive mechanisms should be designed. Through multi-level incentive measures, all parties can be encouraged to actively participate in synergetic innovation, promoting the improvement of educational quality and the enhancement of social service capabilities.

6.1.6. The mechanism for sustainable development and dynamic adjustment

Synergetic innovation is an ongoing process that requires constant dynamic adjustments and optimizations. By establishing regular evaluation and feedback mechanisms and flexible adjustment mechanisms to respond to

socio-economic changes, synergetic innovation mechanisms can be sustained and continuously promoted.

6.2. Research limitations and shortcomings

Although this study conducted an in-depth exploration of the collaborative innovation of vocational, higher, and continuing education and proposed a series of pathways and strategies, certain limitations and shortcomings remain. Firstly, this study is primarily based on literature review and theoretical analysis, lacking empirical data support. Future research can further validate the effectiveness of the proposed synergetic innovation pathways and mechanisms through field investigations and data analysis. Secondly, the pathways and mechanisms proposed in this study are based on general analysis and have not fully considered the economic and social development levels and educational resource conditions of different regions. Therefore, future research should propose more targeted synergetic innovation strategies tailored to specific regional conditions. Additionally, although this study draws on some international experiences, further exploration is needed on how to better integrate these experiences with China's actual conditions. Future research should focus on the localization of international experiences, exploring synergetic innovation models suitable for China's national context.

6.3. Future research outlook

Based on the conclusions and limitations of this study, future research on the collaborative innovation of vocational, higher, and continuing education can be conducted in the following areas. Firstly, empirical analysis should be strengthened, and data collection and case studies should be conducted to further verify the practical effects of synergetic innovation and identify key factors influencing its success. At the same time, further exploration is required on how to more effectively mobilize the enthusiasm of governments, schools, enterprises, and social organizations, establishing closer collaborative relationships, especially in industry-education integration and school-enterprise cooperation, and exploring innovative cooperation mechanisms and models. Finally, with the development of information technology, future research should focus on technology-driven synergetic innovation models, especially how to utilize big data, artificial intelligence, virtual reality, and other technologies to promote the deep integration and innovative development of vocational, higher, and continuing education.

7. Research summary

The collaborative innovation of vocational, higher, and continuing education is not only an essential part of education reform but also a significant driver of social and economic development. Through effective policy support, institutional guarantees, and incentive mechanisms, educational resources can be optimally allocated, talent cultivation quality can be improved, and the education system's sustainable development can be promoted. This study provides a theoretical basis and practical pathways for the collaborative innovation of vocational, higher, and continuing education, and future research should continue to explore empirical research, regional strategies, and technological innovation to further advance China's educational development.

Disclosure statement

The author declares no conflict of interest.

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